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BLACKBIRD MINE
SUPERFUND SITE
RECORD OF DECISION

LEMHI COUNTY
IDAHO

Prepared by

Office of Environmental Cleanup
EPA Region 10

February 2003

PART I: THE DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

The Blackbird Mine Site (Site) is an inactive mine located in Lemhi County, Idaho, approximately 13 miles south of the Salmon River and 25 miles west of Salmon, Idaho. The Blackbird Mine Site covers approximately 830 acres of private patented mining claims and 10,000 acres of unpatented mining claims within the Salmon-Challis National Forest. Mining activities began in the late 1800s and continued until 1982. The EPA identification number is IDD980725832.

STATEMENT OF BASIS AND PURPOSE

The decision document presents the selected remedy for the Blackbird Mine site. This Record of Decision (ROD) has been developed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, 42 USC § 9601 *et seq.*, as amended, and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record for the Blackbird Mine site.

The remedy was selected by the U.S. Environmental Protection Agency. The State of Idaho concurs with the selected remedy contained in this ROD subject to the States' comments previously provided to EPA's Proposed Plan. In accordance with a 1995 Memorandum of Understanding between the EPA and US Forest Service, EPA requested concurrence on the ROD. The U.S. Forest Service also provided a letter of concurrence. The States' and Forest Services' concurrence letters are provided in Appendix C.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

A number of early actions have been implemented at this Site. The selected remedy provides for maintenance of the early action elements and addresses the remaining threats posed by the Site. This ROD addresses contaminated soils (i.e. overbank deposits), groundwater, surface water and instream sediments at the Blackbird Mine site. The selected remedy requires long-term operation and maintenance and includes the following in each drainage basin.

Blackbird Creek Drainage Basin

The remedial actions in the Blackbird Creek basin include:

- Collection and treatment of upper Meadow Creek seeps
- Continued operation of the water treatment plant
- Construction of a soil cover over the West Fork Tailings Impoundment
- Collection and treatment of seepage from the West Fork Tailings Impoundment
- Removal of overbank deposits with armoring of selected deposits
- Removal of in-stream sediments and overbank deposits in the vicinity of the Panther Creek Inn (PCI)
- Establishing institutional controls and physical restrictions
- Natural recovery of Blackbird Creek sediments
- Operation and maintenance of all facilities
- Five year reviews

Bucktail Creek Drainage Basin

The Remedial Actions in the Bucktail Creek basin include:

- Collection and treatment of Bucktail Creek groundwater seeps
- Continued operation of the Water Treatment Plant
- Diversion of Bucktail Creek
- Establishing institutional controls and access restrictions
- Natural recovery of Bucktail Creek, South Fork of Big Deer Creek and Big Deer Creek sediments
- Operation and maintenance of all facilities
- Five year reviews

Panther Creek Drainage Area

The remedial actions in the Panther Creek drainage include:

- Selective removal of overbank deposits
- Establishing institutional controls
- Natural recovery of Panther Creek sediments
- Operation and maintenance of all facilities
- Five year reviews

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The source materials at the Blackbird Mine site could be considered a principal threat waste as defined in EPA guidance.

Because the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the ROD. Additional information can be found in the Administrative Record for the Blackbird Mine site.

- Chemicals of concern (COCs) are provided in Section 7.
- Baseline risk represented by the COCs is provided in Section 7.
- Cleanup levels for COCs and the basis for the levels are provided in Section 8.
- Current and future land and groundwater use assumptions used in the baseline risk assessment are provided in Sections 6 and 7.
- Whether source material constitutes principal threats is found in Section 11.
- Estimated capital, annual operation and maintenance (O & M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected are provided in Section 12.
- Key factors that led to selecting the remedy are provided in Section 12.

AUTHORIZING SIGNATURE

Michael F. Gearheard, Director
Environmental Cleanup Office, Region 10
U.S. Environmental Protection Agency

3 March 2003
Date

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ABBREVIATIONS AND SYMBOLS

AERA	Aquatic Ecological Risk Assessment
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
ARD	Acid Rock Drainage
AWQC	Ambient Water Quality Criteria
bgs	Below ground surface
BMP	Best Management Practices
BMSG	Blackbird Mine Site Group
BRCP	Biological Restoration and Compensation Plan
CCC	Criteria Continuous Concentration (chronic criteria)
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CMC	Criteria Maximum Concentration (acute criteria)
COC	Chemical of Concern
COPEC	Chemical of Potential Ecological Concern
CRP	Community Relations Plan
CSM	Conceptual Site Model
CWA	Clean Water Act
cy	Cubic Yards
DEQ	Department of Environmental Quality
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ESA	Endangered Species Act
ESD	Explanation of Significant Difference
ESV	Ecological Screening Value
FS	Feasibility Study
gpm	gallons per minute
HEAST	Health Affects Assessment Summary Table
HI	Hazard Index
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
HR	Home range
IC	Institutional Controls
IDEQ	Idaho Department of Environmental Quality
IRIS	Integrated Risk Information System

ABBREVIATIONS AND SYMBOLS (continued)

IWQS	Idaho Water Quality Standard
LOAEL	Lowest observed adverse effect level
MCL	Maximum Contaminant Level
MBTA	Migratory Bird Treaty Act
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOEC	No observed effect concentration
NOAEL	No observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resource Damage Assessment
O&M	Operation and Maintenance
PCI	Panther Creek Inn
PEC	Probable effects concentration
PRP	Potentially Responsible Party
PRG	Preliminary Remediation Goal or Preliminary Removal Goal
RA	Risk Assessment
RAO	Remedial Action Objective
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROC	Receptor of Concern
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SF	Slope Factor
SRB	Sulfate-reducing bacteria
TERA	Terrestrial Ecological Risk Assessment
TEC	Threshold Effects Concentration
TEL	Threshold Effects Level
TOC	Total organic carbon
TRV	Toxicity Reference Value
UAA	Use Attainability Analysis
UCL	Upper Confidence Limit
UTL	Upper Tolerance Level
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey

ABBREVIATIONS AND SYMBOLS (continued)

WQS	Water quality standard
WTP	Wastewater Treatment Plant
XRF	X-ray fluorescence

PART II: DECISION SUMMARY

SECTION 1

INTRODUCTION

This Decision Summary provides a description of the site specific factors and analysis that led to the selection of the remedy for the Blackbird Mine Superfund Site. It includes information about the Blackbird Mine Site background, the nature and extent of contamination, the assessment of human health and environmental risks, and the identification and evaluation of remedial alternatives.

This Decision Summary also describes the involvement of the public throughout the process, along with the environmental programs and regulations that may relate to or affect the alternatives. The Decision Summary concludes with a description of the selected remedy in this Record of Decision (ROD) and a discussion of how the selected remedy meets the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended.

Documents supporting this Decision Summary are included in the Administrative Record for the Blackbird Mine site. Key documents include the Remedial Investigation, the Feasibility Study, the Human Health Risk Assessment, the Aquatic Ecological Risk Assessment, the Terrestrial Ecological Risk Assessment, and the Proposed Plan.

1.1 SITE NAME, LOCATION AND DESCRIPTION

The Blackbird Mine Site is an inactive mine located in Lemhi County, Idaho, approximately 13 miles south of the Salmon River and 25 miles west of Salmon, Idaho (See Figure 1-1). The Frank Church River of No Return Wilderness Area is located approximately 5 miles north of the mine site. A portion of the mine is located within a roadless area. The closest permanent resident is approximately 2 miles from the mine area. The identification number is IDD980725832.

The Blackbird Mine Site covers approximately 830 acres of private, patented mining claims and 10,000 acres of unpatented mining claims within the Salmon-Challis National Forest. The mine is situated on a large copper and cobalt deposit. Elevations at the mine range from approximately 6,600 feet to 8,000 feet above sea level. Mining activities began in the late 1800s and continued until 1982. Mining activity resulted in about 14 miles of underground workings, a 12-acre open pit, 4.8 million tons of waste rock deposited in numerous piles, and 2 million tons of tailings disposed of at a tailings impoundment.

The Blackbird Mine site spans two drainages: Bucktail Creek and Meadow/Blackbird Creeks. These drainages flow into Panther Creek, which flows into the main stem of the Salmon River (see Figure 1-1). Acid rock drainage from the waste rock piles, the underground workings, the tailings impoundment, and tailings deposited along area creeks have resulted in the release of elevated levels of hazardous substances to the environment (groundwater, surface water, soils), including but not limited to copper, cobalt and arsenic. These releases have contributed to elevated levels of dissolved copper and cobalt in Panther Creek and its tributaries. Contaminated soil, sediments, waste rock and tailings were also released from the Blackbird Mine site during high water flows from thunderstorms and snowmelt and deposited in soil along the banks of downstream creeks (referred to as overbank deposits/soil) including Panther Creek and its tributaries. Investigations show that irrigation also spread contaminated material along Panther Creek in the overbank soil as well as in pastures. The fisheries and aquatic resources downstream of the Blackbird Mine have been impacted by arsenic, copper and cobalt releases. Dissolved copper concentrations in area creeks downstream from the mine frequently exceed the State of Idaho water quality standard (WQS) for copper for protection of aquatic life.

Natural features of the Site that require special consideration include endangered species, floodplains and wetlands. Historically, the Panther Creek drainage is reported to have supported runs of anadromous chinook salmon and steelhead trout. The Snake River spring/summer chinook salmon (Onchorynchus tshawytscha), known to have historically used this basin, has been designated as threatened under the Endangered Species Act (ESA). Snake River steelhead (Onchorynchus mykiss) and Columbia Basin bull trout (Salvelinus confluentus) are also listed as threatened. Floodplains and wetlands may be present in the riparian zone of area creeks and streams.

Cultural resource surveys have been performed for the Site. No sites listed on the National Historic Register were identified and no other historic properties have been identified.

The U.S. Environmental Protection Agency (EPA) is the lead agency at this site. The support agency is the Idaho Department of Environmental Quality (IDEQ). There are several other agencies that have been actively involved at this site and that have provided extensive input and guidance to EPA; these agencies are collectively known as the natural resource trustees. These include the U.S. Forest Service (USFS), the National Marine Fisheries Service (NMFS), and the National Oceanic and Atmospheric Administration (NOAA). The U.S. Fish and Wildlife Service (USFWS) and NMFS have also been involved during consultations concerning endangered species. Investigations and Early Actions at this site have been conducted under EPA oversight by the Blackbird Mine Site Group (BMSG) which represents the Potentially Responsible Parties (PRPs). The BMSG is composed of the current owner, Noranda Mining, Inc., and former owners and operators M. A. Hanna Company, Hanna Services Company, and Intalco (formerly Alumet Corporation).

SECTION 2

SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 SITE HISTORY

The Blackbird Mine is located at one of North America's largest cobalt deposits. The Blackbird area was discovered in 1893, when the Blackbird Copper-Gold Mining Company consolidated several small prospects and conducted the first significant mining activities from 1893 until 1907. From about 1917 until 1920, the Haynes-Stellite Company mined and milled approximately 4,000 tons of ore from a site located along the east side of Blackbird Creek approximately 1.2 miles downstream of the present Blackbird Mine.

Mining activity slowed until 1938 when the Uncle Sam Mining Company reopened two old adits and built a 75-ton/day flotation mill at the present Blackbird Mine site. The Calera Mining Company (a subsidiary of Howe Sand, which was also actively involved in the mining operations) purchased the Blackbird Mine property in 1943. Full-scale mining activity was initiated in 1949 and was expanded during the 1950s and included the construction of a 1000 ton/day mill.

In 1954, Calera initiated open pit activities in the Blacktail Pit. Excavation of the open pit resulted in the deposition of approximately 3.8 million tons of waste rock in the headwaters of Blackbird and Bucktail Creeks. Prior to full-scale mining, tailings from the mining operation were deposited directly in Blackbird Creek. After 1950, tailings were deposited behind the West Fork Tailings Impoundment, but some tailings "spills" are known to have occurred. It is estimated that 20,000 cubic yards of tailings were deposited or spilled along Blackbird Creek, and an estimated 2 million cubic yards of tailings are impounded behind the West Fork Tailings Impoundment. Underground mining operations during this period also resulted in the formation of a number of waste piles outside mine adits, totaling approximately 1 million tons. Subsequent to mining operations, debris flows, erosion, and acid rock drainage (ARD) have resulted in the spreading of arsenic, cobalt, and copper from the original mining waste disposal areas to downstream locations.

The Calera Mining Company suspended mining operations and sold its interest in the Blackbird Mine to Machinery Center Company in 1963. Between 1963 and 1967, Machinery Center produced copper from the mine primarily through leasing operations. Machinery Center sold controlling interest to the Idaho Mining Company, a subsidiary of the Hanna Mining Company, in 1967. For the next few years, the Idaho Mining Company engaged in an exploration program on the property and initiated meetings with state and federal agencies to obtain authorizations to re-open the mine.

In 1977, Noranda Exploration entered into an option agreement with the Idaho Mining Company, allowing Noranda to explore and acquire interest in the mine property. In December 1979, Noranda Mining, Inc. and Hanna Services Company created the Blackbird Mining Company, a limited partnership, wherein Noranda Mining became the general partner responsible for re-opening the mine. During this same time period, Idaho Mining Company sold all its real and personal property to Hanna Services Company. Noranda Exploration and then the Blackbird Mining Company conducted exploration activities from 1978 to 1982. Exploratory drilling activity included increases to the main Haynes-Stellite Adit openings in order to allow exploration equipment to access the interior of the adit. The Blackbird Mining Company conducted pilot activities at the mine from 1980 to 1982 to determine the feasibility of full-scale operation of the mine. A wastewater treatment plant (WTP) was constructed in 1981 to treat mine drainage from the 6850-foot level of the mine. The Blackbird Mining Company also diverted mine drainage from the 7400, 7200, and 7100-foot levels to the 6850-foot level for treatment by the wastewater treatment plant.

In 1981, the Blackbird Mining Company suspended all pilot operations at the Blackbird Mine and in 1982 ceased all underground activities upon completion of the pilot program. Poor market conditions were identified as the reason that full-scale re-opening of the mine was not pursued by the Blackbird Mining Company.

2.2 SUMMARY OF ENFORCEMENT ACTIONS

Several enforcement actions have been conducted at the Blackbird Mine site to address the releases of contaminants. These include: actions under a Natural Resource Damage claim; emergency response actions to address imminent releases from the West Fork Tailings Impoundment; non time-critical removal actions (the Early Actions) conducted in the Bucktail Creek basin and in the Meadow/Blackbird Creek basin to address water quality and along Panther Creek to address human health concerns; and investigations and studies to complete the Remedial Investigation/Feasibility Study (RI/FS).

2.2.1 Natural Resource Damage Claim

In 1983 the State of Idaho initiated a Natural Resource Damage Assessment (NRDA) for the Blackbird Mine and clean up pursuant to CERCLA. In 1992, the State of Idaho initiated a Natural Resource Damage Assessment (NRDA) for the Blackbird Mine, filing a natural resource damage claim pursuant to CERCLA. Subsequently, the United States joined the suit. In 1995, a Consent Decree (No. 83-4179 *State of Idaho, et al. v. The M.S. Hanna Company et al.*) was lodged committing the defendants (the BMSG) to implementing a restoration plan, meeting water quality standards by a specified date, and implementing the final CERCLA remedy and other response actions selected by EPA through separate consent decrees or administrative orders.

2.2.2 Emergency Response Actions at West Fork Tailing Impoundment

Emergency Response Actions were conducted in 1993 at the West Fork Tailings Impoundment to minimize the potential for release of tailings into Blackbird and Panther Creeks (Figure 2-1). These actions were taken pursuant to an Administrative Order on Consent (AOC) issued by EPA to the BMSG in July 1993 (EPA Docket No. 1093-07-04-106). Prior to these actions, West Fork Blackbird Creek flowed through a buried concrete culvert beneath the tailings pile and there was concern that mass failure of the tailings storage facility was possible if the culvert became plugged. The Emergency Response Actions included the following:

- Construction of a spillway excavated through bedrock and designed and constructed with steps to effectively dissipate kinetic energy and to pass the 500-year flood peak.

- Construction of a new channel for the West Fork of Blackbird Creek over the top of the impoundment to the spillway, which consists of: a riprap-lined flood-flow channel designed to pass the 500-year flood peak; a low-flow channel of reinforced, prefabricated, half-round concrete sections; and a 2-foot-thick compacted clay liner installed beneath the low-flow and riprap-lined flood-flow channel to minimize infiltration into the tailings.

- Installation of a slurry cutoff trench into bedrock near the upstream end of the impoundment to minimize alluvial groundwater discharge into the tailings.

- Filling the existing concrete drainage culvert beneath the tailings with pea gravel to provide drainage of water entering the tailings, thereby maintaining unsaturated tailings in the impoundment.

2.2.3 Non Time-Critical Removal Actions (the Early Actions)

Non time-critical removal actions (the Early Actions) were initiated during the summer of 1995 and were continued in five phases each year through 2001. These actions were conducted pursuant to an AOC issued by EPA to the BMSG in June 1995 (EPA Docket No. 10-95-0083). From 1995 through 1998, the Phases I, II, and III Early Actions were focused on controlling sources of acid rock drainage that were impacting water quality. Generally, Phase I facilities were built during the 1995 construction season, Phase II facilities were built during the 1996 and 1997 construction seasons, and Phase III structures were initiated during the 1997 construction season and completed during the summer of 1998.

Phases IV and V Early Actions have consisted of overbank deposit removal actions, which have been conducted along Panther Creek and Blackbird Creek to mitigate potential risk to human health associated with elevated levels of arsenic present in mine related deposits. These actions have also reduced potential risk to terrestrial and aquatic ecological receptors. Phase IV activities were initiated in 1998 and completed in 1999. Phase V activities were initiated in 1999; however, the forest fire during 2000 caused delays and Phase V was not completed until 2001. Figure 2-2 depicts the Early Action facilities at the mine site.

During the fall of 2002, additional Early Actions were performed under the 1995 AOC to collect waters in the Bucktail Creek and Meadow Creek drainage basins that were not intercepted during previous actions.

In Meadow/Blackbird Creek, the Early Actions included the following:

- Construction of the 7100 level earthen clay-core dam to collect and store water draining from the waste rock dumps in the Meadow Creek drainage basin before treatment. The 7100 level dam is approximately 88 feet high, and impounds a reservoir with a maximum surface area of 2.56 acres and a maximum storage capacity of 49 acre-feet.

- Pipelines from the 7100 level dam to the water treatment plant and replacement of piping and instrumentation between the bulkhead at the 6850 adit and the water treatment plant. The bulkhead allows for storage of up to 50 acre-feet of water in the mine workings.

- Upgrade to and expansion of the existing water treatment plant, which is located approximately 1,200 feet downstream from the confluence of Meadow Creek and Blackbird Creek. The upgraded treatment plant has a normal maximum treatment capacity of 800 gallons per minute (gpm) and discharges treated water to Blackbird Creek.

- Installation of a sludge pipeline from the water treatment plant to the Hawkeye Ramp workings to dispose of sludge generated by the water treatment plant.

- Construction of a contaminated water collection system below the 7800 waste rock pile. The collection system is composed of ditches and pipelines to collect and transport contaminated water to the 7100 level dam reservoir.

- A series of clean water ditches and pipelines to divert clean water around the contaminated areas and the 7100 level dam reservoir, and transport clean water downstream of the 7100 dam.

- Relocation of waste rock from the canyon walls of Meadow Creek and Blackbird Creek and from Hawkeye Gulch. The relocated waste rock was deposited upstream of the 7100 level dam in the 7400 level waste rock dump, or placed in the Meadow Creek and Blackbird Creek bottoms.

- The waste rock in the Meadow Creek and Blackbird Creek bottoms was covered with a clean earth cover. Drains were installed beneath the cover to collect contaminated groundwater and transport it to the water treatment plant.

- Concrete channels were constructed across the top of the capped waste rock to convey Meadow Creek and Blackbird Creek to a discharge point in Blackbird Creek downstream of the water treatment plant.

- Construction of a groundwater cutoff wall in upper Blackbird Creek about 300 feet upstream of the water treatment plant to intercept contaminated groundwater flowing through the waste rock beneath the cover. The contaminated groundwater is piped to the water treatment plant.

- Construction of a temporary sediment control basin to settle out sediment generated during and after construction activities. The sediment control basin is located at the downstream end of the Blackbird Creek concrete channel.

- Removal of visually obvious, erodible tailings from overbank deposits at several locations along Blackbird Creek between the confluence of Blackbird Creek and Panther Creek.

- Construction of three sediment basins along Blackbird Creek. One of these basins is located near the West Fork Tailings Impoundment, and the other two basins are located upstream of the confluence of Blackbird Creek and Panther Creek, just upstream of the Panther Creek Road.

Within the Bucktail Creek drainage, the Early Actions included the following:

- Construction of an earth fill clay-core dam (7000 level dam) and pipeline and open-channel spillway to collect, store, and divert contaminated water to the water treatment plant via the 6930 level adit to the underground mine workings. The 7000 level dam is approximately 70 feet high and impounds a reservoir with a maximum surface area of 0.52 acre and a maximum storage capacity of 5.85 acre-feet.

- Construction of a new adit at elevation 6930 to connect to the 6850 level of the old mine workings. The 6930 level adit extends approximately 1,300 feet into the mountain and is used to transport the contaminated water from the Bucktail Creek basin into the mine, where it can be conveyed to the water treatment plant.

- Construction of a pump station and pipeline located downstream of the 7000 level dam. The pump station and pipeline is used to collect and convey springs and dam seepage and pump it to the 6930 adit for transport through the mine to the water treatment plant.

- Relocation of waste rock piles, with disposal in the Blacktail Pit.

- A waste rock repository (Blacktail Pit), including a foundation drainage system to drain water entering the former pit into the old mine workings and to the water treatment plant.

- A series of clean water ditches and pipelines to divert clean water around the waste rock dumps and the 7000 level dam reservoir, and transport the clean water to Bucktail Creek downstream of the 7000 level dam.

- The 7200 level collection ditch to collect contaminated water from the remainder of the West Lobe waste rock dump and direct the contaminated water toward upper Bucktail Creek upstream of the 7000 level dam.

- A series of sediment control ditches within the waste rock to remain in place.

- Debris traps located in the Bucktail Creek channel to reduce the risk of debris flows.

- Two temporary sediment control dams to settle out sediment generated during construction activities and sediments from residual debris flow materials along Bucktail Creek. The upper sediment control dam is located just upstream of the upper access road crossing of Bucktail Creek and downstream of the pump back station. The lower sediment control dam is located just upstream from the lower access road crossing of Bucktail Creek.

- Relocation of a portion of the debris flow material along Bucktail Creek between the upper and lower sediment dams. This debris flow material was disposed of in the Blacktail Pit.

- Rehabilitation of the 6850 level to allow for the transport of contaminated water from the Bucktail drainage to the water treatment plant and allow for ingress/egress of men and materials to the 6850 bulkhead.

Beginning in late 1998 and continuing from 1999 through 2001, overbank deposit removal actions were conducted along portions of Panther Creek. These actions were primarily focused on removal of mine-related materials containing elevated concentrations of arsenic, concluded by EPA to pose an unacceptable risk to human health. The removal actions have also reduced any risk that these materials may have posed to terrestrial and aquatic ecological receptors. The overbank deposit removal actions included the following:

- Removal of the contaminated materials until testing indicates that the underlying soils are below the Preliminary Removal Goals (PRGs), or until the water table is reached.

The PRGs varied from 100 mg/kg arsenic for a residential exposure scenario, 280 mg/kg arsenic for a camping scenario, and 590 mg/kg arsenic for a day-use recreational exposure scenario.

- Removed materials were hauled to the West Fork Tailings Impoundment for disposal.

- Following removal, clean soils were used to backfill the excavated areas. The depth of clean soils depended on site conditions and the amount of material removed. The soils were generally replaced to the original lines and grades. The soils were replaced to a minimum depth of 6 inches. If materials exceeded the PRG at the water table, the minimum depth of soil replacement was 12 inches.

- The top 6 inches of replacement soils where composed of topsoil to act as a growth medium. The topsoils were then revegetated to match the pre-removal vegetation (either native species or pasture grasses).

Removal Actions were completed at the following areas:

- Panther Creek Inn (PCI) and the PCI campground area for ¼ mile downstream along Panther Creek.

- The Riprap Bar area approximately 1 mile downstream from the Cobalt Townsite.

- The (b) (6) [redacted] area located approximately 2 miles downstream from the Cobalt Townsite.

- Deep Creek Campground located just upstream of the confluence of Deep Creek and Panther Creek.

- The (b) (6) [redacted] property located about 5.5 miles upstream from the confluence of Panther Creek and the Salmon River.

- The Cobalt Townsite and the adjacent pasture area immediately downstream of the Cobalt Townsite. Additional work to improve juvenile rearing habitat for salmonids was also conducted as part of the Biological Restoration and Compensation Plan (BRCP).

- At the Napias Creek area just upstream from the confluence of Napias and Panther Creeks.

In the fall of 2002, ongoing Early Actions were performed in Meadow Creek and Bucktail Creek, including the following:

Upper Meadow Creek Facilities

In the fall of 2002, work was initiated in upper Meadow Creek including the construction of:

- The 7560 Detention Dam and Piping. The facilities include a small earthfill detention dam and piping system that will convey clean water around the existing 7350 Detention Dam and into the 7100 West Diversion System.

- The 7560 Access Road and Ditch. A new road and diversion ditch will be built between the 7350 Detention Dam and 7560 Detention Dam.

- The 7350 Detention Dam piping modifications. The piping in the area of the existing 7350 Detention Dam will be modified to separate clean water from water with high metals concentrations.

Phase 1 Bucktail Creek Facilities

In the fall of 2002, Phase 1 Bucktail Creek facilities were constructed upstream from the existing Bucktail Creek pump station, including construction of:

- The East Fork Bucktail Cutoff Wall. The cutoff wall will intercept the flow of alluvial groundwater in Bucktail Creek and convey it by gravity to the existing vault at the Bucktail Pump Station.

- The BTSW-3C discrete seep collection facility. A seep identified as BTSW-3C, located just upstream of the existing Bucktail Pump Station, contributes significant copper and cobalt loading to Bucktail Creek. A discrete seep collection system will be installed to collect and convey the waters of this seep to the Bucktail Pump Station.

- A new pipeline from the Bucktail Pump Station to the 6930 Portal to provide for additional flows captured by the cutoff wall and seep collection facility. Pipeline modifications will include construction of a new 4-inch diameter pumpback pipeline, buried in a trench parallel to the existing 3-inch diameter pipeline.

2.2.4 Remedial Investigation/Feasibility Study (RI/FS)

The RI/FS activities have been conducted pursuant to an AOC issued by EPA to the BMSG in November 1994 (U.S. EPA Docket No. 10-94-0222). The RI was initiated in 1995; however, much of the data collection (especially water quality data) concentrated on the period after Phases I through III of the Early Actions were completed in 1998. The Early Actions improved water quality in the area creeks downstream from the mine, and the focus of the RI was to address contamination remaining after completion of the Early Actions. The RI was completed in November 2001. The results of the RI are summarized in Section 5 of this ROD. The FS evaluated alternatives to address the contamination remaining after the Early Actions were completed. The FS was completed in June 2002. The results of the FS are summarized in Section 9 of this ROD.

SECTION 3

COMMUNITY PARTICIPATION

This section summarizes the community involvement activities undertaken by EPA during the remedy selection process. EPA developed a Community Relations Plan (CRP) in April 1995. The CRP is designed to promote public awareness of cleanup activities and investigations and to involve the public in the decision-making process. Community participation activities throughout the RI/FS and Early Actions have included personal interviews, public meetings and distribution of fact sheets, newspaper ads, and public notices.

The RI/FS Reports and Proposed Plan for the Blackbird Mine Site were made available to the public in August 2002. These documents, along with others that form the basis for the cleanup decisions for the Blackbird Mine Site, can be found in the Administrative Record located at the the EPA Region 10 Superfund Records Center at 1200 Sixth Avenue in Seattle Washington, the EPA Region 10 Idaho Operations Office at 1435 N. Orchard in Boise Idaho, and the Salmon Public Library at 204 Main Street in Salmon, Idaho. Notice of the availability of these documents was published in the Salmon Recorder-Herald and the Challis Messenger on August 8 and 22, 2002.

A fact sheet summarizing the Proposed Plan was mailed to approximately 400 individuals on the Site mailing list.

A public comment period was held from August 12 to October 10, 2002. Initially, the public comment period was to end on September 10, 2002 but was extended to October 10, 2002 in response to two requests for an extension. The comment period extension was published in the two local newspapers on September 19, 2002. A public meeting to present the Proposed Plan was scheduled for August 26, 2002. The public meeting was canceled due to EPA concerns about maintaining public safety and security in light of a threat to disrupt the meeting. The public meeting was not rescheduled because only two people requested it. These people were contacted and were provided an opportunity to ask questions and communicate their concerns to EPA.

Comments were received during the public comment period. A responsiveness summary is provided as part of this ROD.

SECTION 4

SCOPE AND ROLE OF RESPONSE ACTION

Early Actions have been implemented at the Site as described in Sections 2.2.2 and 2.2.3 of this ROD, and are incorporated into the final remedial action for the Site. The Blackbird Mine ROD is the final action for the Site and addresses soils, groundwater, sediment and surface water at the Blackbird Mine Site.

The remedy selected by EPA and documented in this ROD includes remedial actions necessary to protect human health and the environment. The human health risk assessment determined that exposure to soils along the banks of Panther Creek (overbank deposits) poses a potential risk from arsenic to humans under a future residential use scenario. In addition, small localized areas of soil along the banks of Blackbird Creek with elevated arsenic concentrations may pose unacceptable acute (short-term) or chronic (long-term) risks during recreational use. The selected remedy is intended to mitigate or abate the risks posed by the Blackbird Mine site to humans. Contaminated overbank deposits will either be removed and/or institutional controls will be put in place to prevent future contact with contaminated soils. In addition, removal of contaminated overbank deposits along Blackbird Creek will reduce the potential for mobilizing the soils during high runoff events and deposition of soils on downstream properties along Panther Creek.

The aquatic risk assessment determined that there was a potential risk to aquatic life from copper and cobalt in surface water and copper, cobalt and arsenic in sediments in Blackbird Creek, Bucktail Creek, South Fork of Big Deer Creek, Big Deer Creek and Panther Creek. The selected remedy is intended to mitigate or abate the risks posed by the Blackbird Mine site to aquatic life. This will be accomplished by collection of groundwater and surface water for treatment at the existing water treatment plant, removal of overbank deposits along Blackbird Creek and natural recovery of instream sediments. In addition, in order to achieve State Water Quality Standards in South Fork of Big Deer Creek, Bucktail Creek will be diverted around South Fork of Big Deer Creek.

The terrestrial risk assessment determined that there were risks to terrestrial sub-populations only in the Blackbird Creek riparian areas. However, the population-level risks along Blackbird Creek were considered negligible. The sub-population and population-level risks to terrestrial receptors of concern at all other areas of the Site were considered negligible. Thus, the selected remedy does not include actions specifically to address terrestrial life.

Given the uncertainties associated with the effectiveness of the remedy selected in this ROD there may be the need for contingency actions in the future which, if necessary, will be documented in a future ESD or ROD amendment. Potential contingent actions are described in Section 12 of this ROD.

SECTION 5

SUMMARY OF SITE CHARACTERISTICS

5.1 SITE CHARACTERIZATION

This section provides an overview of the Site and a summary of the remaining contamination to be addressed through remedial actions. This includes descriptions of the conceptual site model, physical setting, habitat impacts, remedial investigation sampling results, and a summary of remaining sources.

5.2 CONCEPTUAL SITE MODEL

The Conceptual Site Models (CSM) for human, aquatic, and terrestrial receptors are shown respectively in Figures 5-1 through 5-3. The potential human receptors of concern include recreational users and future residents. The primary sources of contamination for human receptors are overbank tailings and soils that contain elevated concentrations of arsenic along Blackbird Creek at the mine and along Panther Creek downstream of the mine. The potential aquatic receptors of concern include benthic macroinvertebrates and anadromous and resident salmonid species (including several threatened or endangered species) in creeks within the mine and downstream of the mine. The primary contamination sources include tailings and waste rock that discharge elevated concentrations of cobalt and copper through springs and seeps to the surface waters. The potential terrestrial receptors include a variety of species that inhabit and visit the site. The primary sources of contamination include waste rock and overbank tailings and soils that contain elevated concentrations of arsenic.

5.3 PHYSICAL SETTING

Descriptions of the physical setting at the Site, including topography, geology, meteorology, surface water hydrology, and hydrogeology are summarized below.

5.3.1 Topography

The Blackbird Mine Site covers approximately 830 acres of private patented mining claims and 10,000 acres of unpatented mining claims within the Salmon-Challis National Forest. Mining activity within the site resulted in about 14 miles of underground workings, a 12-acre open pit, 4.8 million tons of waste rock in numerous piles, and two million tons of tailings disposed of at a tailings impoundment.

The mine site lies within two primary drainages: Meadow/Blackbird Creek and Bucktail Creek. Figure 5-4 shows the primary features in these drainage areas. The Blacktail Open Pit was part of the Bucktail Creek drainage basin but has been partially filled with waste rock, removed as part of Early Actions described in Section 2, and now drains to the underground mine workings.

Meadow Creek is the southern drainage of the mine site. This basin formerly contained the surface mine facilities. Waste rock from the Blacktail Pit was disposed at the 7800 dump at the headwaters of Meadow Creek and waste rock from underground adits was disposed along the valley sides and bottom. Meadow Creek extends from the basin boundary near an approximate elevation of 7,800 feet for 1.5 miles to its confluence with Blackbird Creek near the wastewater treatment plant at an elevation of 6,800 feet. The basin area is very steep, as is the Meadow Creek channel, which exhibits an 11 percent grade.

The Blackbird Creek basin is separated into two portions by the clean water reservoir. The upper section of the basin, located west of Meadow Creek and upstream of the dam, has not been impacted by mining activities. Flows from the upper Blackbird Creek basin flow into the Blackbird Creek channel at a point approximately ¼ mile upstream of the water treatment plant. Blackbird Creek (below the clean water reservoir) and Meadow Creek are conveyed in a concrete channel constructed as part of Early Actions. The channel runs from below the 7100 dam to just downstream of the water treatment plant, and was constructed on top of a clean soil cover, which was installed as part of the Early Actions to cover waste rock in the valley bottom. Blackbird Creek discharges to its normal channel at a culvert located immediately downstream of the treatment plant. From the mine site, Blackbird Creek flows for approximately 3 miles where it is joined by the West Fork Blackbird Creek. The West Fork Tailings Impoundment is located at the confluence of Blackbird Creek and West Fork Blackbird Creek. Blackbird Creek then flows approximately 2 miles downstream of West Fork Blackbird Creek to its confluence with Panther Creek. The Blackbird Creek drainage basin covers approximately 23 square miles, which includes the Meadow Creek and West Fork Blackbird Creek drainage basins.

Prior to Early Actions, Bucktail Creek drained an area of approximately 1.7 square miles, which included the northern portion of the mine area and several sub-basins. The headwaters of Bucktail Creek originated just below the Blacktail Pit. Following completion of the Early Actions described in Section 2, the flow from the upper section of Bucktail Creek below the waste rock dumps is now collected at the 7000 dam and downstream pumpback station and diverted to the underground mine, from where it is withdrawn for treatment and discharge to Blackbird Creek. Downstream of the 7000 dam, Bucktail Creek flows north approximately 1.8 miles to its confluence with the South Fork Big Deer Creek. Downstream of the 7000 dam, the high gradient creek drops approximately 1500 feet to an elevation of about 5500 feet at the confluence with the South Fork Big Deer Creek. The South Fork Big Deer Creek flows about 0.5 miles to its confluence with Big Deer Creek. Big Deer Creek then flows east about 2.8 miles to its confluence with Panther Creek, about 8 miles upstream from the Salmon River.

Panther Creek is a major tributary of the Salmon River, which in turn flows into the Snake River. The Panther Creek drainage consists of steep, rocky slopes and is characterized by

V-shaped canyons. Panther Creek drains approximately 533 square miles, and is approximately 44 miles long from its headwaters to the Salmon River confluence. Elevation ranges from about 3,280 feet at the mainstem confluence to about 10,000 feet at the headwaters.

5.3.2 Geology

The geological setting of the Blackbird Site is dominated by metasedimentary rocks, with relatively thin alluvial deposits in the active stream channels. Bedrock in the mine area consists primarily of the Proterozoic Yellowjacket formation. Within the Blackbird Mountain quadrangle, the Yellowjacket Formation is divided into two major mapping units, a lower "phyllite" member and an upper "quartzite" member. Rocks in the mine area are thinly laminated and bedded micaceous quartzites, which generally dip 45 degrees north-northeast. Within the mine area, any stratigraphic correlation of more than a few feet is reportedly difficult because of intense structural deformation and metamorphism.

Major structural features in the mine area include the White Ledge shear zone and the Slippery Creek fault, which bound the occurrence of mineralization. The Blackbird Structural Block is defined as the area between these features. The White Ledge shear zone is a series of northerly trending faults in the Blackbird Mine area, and marks the western boundary of mineralization in the area. It is visible as a massive shearing zone in the Blacktail Pit. The Slippery Creek fault marks the eastern boundary of mineralization in the Blackbird Mine area. The fault is north-northwest trending and is distinguished by a lithological change, with schistose units on the west side and massive quartzite on the east. The fault crosses Blackbird Creek about 1 mile downstream from the Water Treatment Plant and extends northward through Hawkeye Gulch.

5.3.3 Meteorology

The annual average temperature at the Blackbird Mine Site is 36 degrees F. Average maximum temperature ranges from 25 degrees F in January to 75 degrees F in July. The average minimum temperatures range from 5 degrees F in January to 42 degrees F in July. The summer season climate is described as cool, dry, with occasional thunderstorms and relative humidity less than 25%.

The average annual precipitation at the mine site, based on a 10-year period, is 20 inches. The highest mean precipitation occurs in June and the lowest occurs in September. More than half of the precipitation occurs in the spring and winter months, and 30% occurs during spring alone. The greatest precipitation recorded in one month at the mine site was recorded in May at 5.3 inches and the highest annual total was 25 inches. Snow depth on the ground during January and February ranges from 5 to 17 inches.

Prevailing winds are from the west; however, they are altered by the surrounding terrain in the area of the mine site. Canyons and ridges in the area tend to channel the winds. Winds on the

Blackbird Creek side of the site tend to be channeled upslope and winds on the Bucktail Creek side tend to be channeled downslope. The data record for the mine site indicated that winds less than 11 mph occurred more than 64% of the time and high wind occurrences, consisting of wind speeds in excess of 30 mph, were recorded less than 2% of the time.

5.3.4 Surface Water Hydrology

The snowpack runoff volume, rate, and distribution in time were evaluated during the Early Actions to establish hydrologic design criteria for the site. Runoff from the 500-year 24-hour storm was used to determine peak flows as the design criteria for conveyance facilities. The 100-year snowmelt hydrograph was used as the design basis for determining the amount of storage and treatment capacity needed. The 500-year precipitation was established as 3.15 inches in 24 hours, with an SCS Type II temporal distribution.

Stream gauging was conducted from 1995 through 2002 as part of both Early Action and RI activities at several stations in Blackbird Creek, Panther Creek, South Fork Big Deer Creek, and Big Deer Creek. Continuous gauging was conducted during snowmelt runoff through base flow conditions in the fall. Transducers were removed prior to the onset of winter to prevent damage from freezing.

5.3.5 Hydrogeology

Groundwater at the Blackbird Site occurs both in unconsolidated surficial deposits and as fracture-controlled bedrock systems. Hydrologic communication exists between these two flow systems and with area surface waters. Groundwater discharge to the surface water via several adits associated with the mine workings occurred prior to the implementation of Early Actions. These adit discharges were controlled as part of the Early Actions. Groundwater also discharges as seeps and springs.

5.3.5.1 Groundwater Flow in Unconsolidated Surficial Deposits

Alluvial deposits in stream valleys and deposits of mine waste both serve as local, surficial pathways for groundwater flow and potential contaminant transport. Hydrologic communication between surface water, alluvial deposits, mine waste material, and bedrock occurs within the mine area. Many seeps are located at the foot of waste piles and may represent both discharge of infiltrated precipitation and groundwater discharge occurring underneath the waste pile. Most of these were controlled as part of Early Actions. Groundwater seeps not controlled by Early Actions were investigated as part of the RI.

Several monitoring wells were installed within alluvial deposits during investigations conducted prior to the RI, including upstream and downstream of the Slippery Creek Shear Zone and downstream of the West Fork Tailings Impoundment. These wells were monitored during the RI and are shown on Figure 5-4.

Meadow Creek/Upper Blackbird Creek Area

Alluvial groundwater in Meadow Creek and the upper portion of Blackbird Creek flows through waste rock in the valley bottom that was capped as part of Early Action activities. Following completion of Early Actions, the alluvial groundwater has been intercepted by a cutoff wall near the Water Treatment Plant and transported to the plant for treatment. Downstream of the cutoff wall, alluvial groundwater eventually discharges to Blackbird Creek.

Bucktail Creek Area

Alluvial deposits in this area are relatively thin. Upward gradients of 0.3 to 0.9 are present within nested bedrock wells (BTMW-03B and BTMW-03C) on the east side of Bucktail Creek, indicating that groundwater discharge to the thin alluvial deposits associated with Bucktail Creek, and ultimately to the creek itself, is likely in this area. On the west side of Bucktail Creek, water level data from BTMW-04B and BTMW-04C indicate that a low downward hydraulic gradient to no gradient (0.1 to 0.0) is present.

The source of the remaining loads in Bucktail Creek is likely from the groundwater system that is expressed between the 7000 Dam and station BTSW-01.6. This is supported by the data from the monitoring wells and the synoptic surface water sampling (see Section 5.3.5). The source of the metals in the deep groundwater system cannot be established with certainty, but could be the result of waste rock or the mine workings.

West Fork Tailings Impoundment

Eleven monitoring wells were installed in and adjacent to the West Fork Tailings Impoundment during the spring of 1993. Nine of the wells are completed in alluvial materials and two are completed in bedrock. Based on water level and pump test data from the wells, it was concluded that:

- Static water levels indicate that the tailings are dewatered and well drained;
- The unconfined alluvial aquifer and the bedrock aquifer are hydraulically connected; and
- Hydraulic conductivity within the alluvial aquifer ranges from 1.0×10^{-4} cm/s to 3.5×10^{-5} cm/sec.

Groundwater seepage from the West Fork Tailings Impoundment discharges to Blackbird Creek downgradient of the dam.

5.3.5.2 Groundwater Flow in Bedrock

Bedrock groundwater flow is controlled by structural features, including faults, fractures, joints, and mining related features. Primary permeability of the rock is assumed to be very low. Northwest trending fractures and faults between the White Ledge shear zone and the Slippery Creek fault have likely controlled groundwater flow and associated hydrothermal ore emplacement. The RI reported that the major fracture pattern strikes N10 degrees W to N50 degrees W and dips from 25 degrees to 60 degrees east. The RI also noted that at the 6850-foot level, groundwater was observed flowing to the adit along fractures, supporting the conclusion that the fractures are the primary pathway for groundwater movement. The RI suggests that the direction of groundwater flow follows the northeast dip of the ore bodies, based on tracer experiments conducted in diamond drillholes within the mine.

Field data from monitoring wells and drillholes indicate that the upper portion of Meadow Creek (near the 7100 Portal) loses water to the groundwater system, while further downstream, near the water treatment plant, Meadow Creek is gaining water from the groundwater system.

Numerical groundwater flow modeling was performed to evaluate the influence of the Blackbird Site workings on the regional groundwater flow system and to evaluate the potential for water losses to groundwater during use of the mine for water storage. Based on the field data and on the results of all the numerical modeling simulations, the following conclusions were made:

- The Blackbird Site workings significantly alter the regional groundwater flow system by creating a large area of drawdown. Upward hydraulic gradients are present below the mine workings. The upward gradients persist when the mine water level is elevated from 6850 feet to 7120 feet.

- Groundwater recharge and discharge into Meadow Creek are controlled by mine water levels, and an increase in mine water levels would be expected to reduce the length of Meadow Creek losing water to the groundwater system.

None of the modeling scenarios predicted flow from the mine area into the Little Deer Creek drainage. In fact, the presence of the mine workings induces flow from east of the topographic divide between Meadow Creek and Little Deer Creek into the mine workings.

5.3.5.3 Groundwater at the Mine Site

Groundwater at the mine site has been characterized during the RI by collection of water quality samples from 11 monitoring wells – two wells in the Blackbird Creek drainage, three wells in the Bucktail Creek drainage, and six wells at the West Fork Tailings Impoundment.

Blackbird Creek Drainage

Two sets of nested wells have been monitored during the RI in the Blackbird Creek drainage. Well set BBMW-01 is located about 700 feet downstream from the water treatment plant. It consists of three wells (A, B and C) screened respectively at 11 to 16 feet, 25 to 35 feet, and 51 to 61 feet. Well set BBMW-02 is located across the Blackbird Creek channel from the water treatment plant. It also consists of three wells (A, B and C) screened respectively at 12 to 17 feet, 40 to 50 feet, and 85 to 95 feet.

Bucktail Creek Drainage

Three monitoring wells have been sampled in the Bucktail Creek drainage during the RI. Well BTMW-03B is located just downstream from the upper sediment dam. It is screened in the shallow bedrock at 37 to 47 feet below ground surface (bgs). The other two monitoring wells are located at the West Lobe removal area. Monitoring well BTMW-9601 is located downgradient from the removal area and is screened at 7.5 to 27.5 feet bgs. Monitoring well BTMW-9602 is located upgradient from the removal area and is screened at 15 to 35 feet bgs.

West Fork Impoundment Area

Six monitoring wells were sampled in the vicinity of the West Fork Impoundment during the RI. Three of these wells (WFMW-1, 2 and 4) are located downgradient from the West Fork Dam. Three of the wells (WFMW-6, 11 and 13) are located within the tailings impoundment itself. Screening depths below ground surface are not known because many of the well casings were altered subsequent to the drilling of the wells in 1993. Screened intervals were generally 15 or 20 feet in depth and were placed to characterize the groundwater within the bedrock and in the materials above the bedrock.

Sampling Results

Ranges of COCs measured from monitoring well sampling for the various locations are shown in Table 5-1a. These data were collected in 1995, 1999 and 2000.

Table 5-1a Summary of Monitoring Well Data at the Mine Site				
Contaminant of Concern	**Blackbird Creek Wells (mg/L)**	**Bucktail Creek Wells (mg/L)**	**West Lobe Wells (mg/L)**	**West Fork Impoundment Wells (mg/L)**
Arsenic	0.001 to 0.070	0.001 to 0 020	0.002U to 0.04U[a]	0.006 to 0.0945
Cobalt	0.003U to 3.05	0.003U to 12.2	0.004 to 0.223	0 005U to 21.2
Copper	0.003U to 1.13	0.048 to 42.1	0.003U to 0.075	0 003 to 0.972

U = Non-detect
[a] All samples were non-detect

5.3.5.4 Groundwater in Private Water Supply Wells

In addition to the monitoring wells sampled at the Blackbird Mine, one round of sampling was conducted at five residential water supplies in the vicinity of the mine during 1995. The Panther Creek Inn (PCI) Well No. 1 was sampled in June 1995 and the other water supplies were sampled in late September 1995. A second well was constructed at the PCI property in 2000. Both Panther Creek Inn wells (Nos. 1 and 2) were sampled in September 2002. Residential wells and water supplied by springs to private residences in the vicinity of the Blackbird Mine Site are shown on Figure 5-4.

Results of analyses are presented in Table 5-1b. Arsenic was detected at concentrations exceeding the new Safe Drinking Water Act (SDWA) maximum contaminant limit of 0.010 mg/L in samples collected from the [redacted] water supply, the [redacted] well, and at PCI Well No. 2. The arsenic concentration in the [redacted] water supply was 0.078 mg/L. However, the low levels of cobalt and manganese detected in the [redacted] water supply indicate that this source is not likely to have been impacted by the mine site (the mine waters are typically elevated in cobalt and manganese). In addition, the [redacted] water supply is a spring located several hundred feet above the elevation of Panther Creek. The elevated arsenic concentration apparently results from natural mineralization in the area and is not a result of the Blackbird Mine Site. Arsenic in the [redacted] well was 0.023 mg/L. However, the low levels of cobalt and manganese in the well waters indicate that this source is not likely impacted by the mine site. The arsenic in PCI Well No. 2 was 0.016 mg/L. However, the manganese in PCI Well No. 2 is significantly higher than would be expected from mining-related sources. In addition, the overall groundwater chemistry, the odor, and color in the water from this well indicate a localized source. EPA has recommended that PCI Well No. 2 be abandoned and plugged.

5.4 REMEDIAL INVESTIGATION SAMPLING RESULTS

Remedial investigations were conducted from 1995 through 2001 and are described in detail in the *Final Blackbird Mine Site Remedial Investigation Report* and in the *Remedial Investigation Addendum - 2001 Sample Results*. Remedial investigations included studies to determine the nature and extent of contamination in waste rock deposits, tailings deposits, surface waters, in-stream sediments, overbank soils, and groundwater at the Blackbird Mine site and surrounding area. These investigations included an evaluation of the quantity and concentrations of metals (mass loading) released from known or potential sources during various hydrologic conditions. The Early Actions have resulted in a reduction in dissolved metals transported in surface water from the mine area. A major focus of the investigations was to determine the mass loading of metals from residual and remaining sources following implementation of the Early Actions.

The RI investigations conducted during 1995 included comprehensive investigations to evaluate the nature and extent of contamination prior to implementing Early Actions. Post-Early Action investigations to evaluate improvements to water quality began in the Spring of 1998 for the portion of the Site that includes Meadow and Blackbird Creeks, and in the Fall of 1998 for the portion of the Site that includes Bucktail, South Fork Big Deer, and Big Deer Creeks.

Information developed during the RI was also used to complete both human health and ecological risk assessments. The summaries of the risk assessments are included in Section 7 of this ROD. The sampling results for each of the media at the Site are summarized in the following sections.

5.4.1 Waste Rock Deposits

Table 5-2 summarizes the available concentration data for waste rock in the areas remaining after Early Actions. The data reflect waste rock encountered in test pits and boreholes completed in known waste rock deposits. Table 5-2 reports the range, mean, and median concentrations of arsenic, copper, and cobalt (where available) in each area. Median concentrations are discussed here because in some areas the mean values were artificially elevated by single samples with unusually high (but presumably valid) concentrations. Cobalt concentrations were generally not reported because most of the samples tested below the detection limit for cobalt of the x-ray fluorescence (XRF) instrument (detection limit is1,500 mg/kg cobalt).

Among the remaining waste rock that was sampled, the waste rock in the eastern portion of the West Lobe has the highest median concentrations for both copper (1,850 mg/kg) and arsenic (1,155 mg/kg). However, the maximum sampled concentrations for copper (20,200 mg/kg) and arsenic (5,900 mg/kg) were located in the 7800 Waste Rock Dump. The Haynes-Stellite area had the lowest median copper concentration and the second lowest median arsenic concentration from among the sampled areas.

5.4.2 Tailings Deposits

Approximately two million tons of tailings were deposited in the West Fork Tailings Impoundment during the active mining operations. An unknown quantity of tailings were also deposited in overbank areas along the streams downstream from the mine during high flow events.

5.4.2.1 West Fork Tailings Impoundment

Soil sampling was conducted on the surface of the West Fork Tailings Impoundment following completion of 2001 removal activities. Sampling was conducted along five transects across the impoundment with four samples collected from each transect. Transect 1 was located near the dam, with the other four transects spaced about 300 feet apart between the dam and the upstream limit of the impoundment. The samples were composited and analyzed using the XRF instrument. The results of the sampling are included in Table 5-3. Transect 1 (nearest the dam) had the highest arsenic and iron concentrations (554 and 39,900 mg/kg, respectively). Transect 5 (near the upstream end of the impoundment) had the highest copper concentration at 650 mg/kg.

5.4.2.2 Overbank Deposits

Overbank tailings and waste rock materials were deposited along Bucktail Creek, Big Deer Creek, at the Panther Creek Inn (PCI) and along Panther Creek downstream from the Panther Creek Inn. Many of these deposits were removed as part of the Early Actions. Details of the removal actions are provided in Section 2 of this ROD.

<u>Bucktail Creek</u>

A significant debris flow occurred in Bucktail Creek due to a large thunderstorm on July 31, 1994. The debris flow transported soil and mine waste along the length of the creek to its confluence with South Fork Big Deer Creek. A significant portion of the debris flow materials were removed during the Early Actions; however, it was not practical to remove many of the smaller deposits. Following the removals, debris and waste rock samples were collected along the valley bottom along lower Bucktail Creek between the Upper and Lower Bucktail Creek Sediment Control Dams. The results of the sampling are shown in Table 5-4. Additional discussion of overbank deposits along Bucktail Creek is included in Section 5.3.4.

Big Deer Creek

Along Big Deer Creek and South Fork Big Deer Creek, no removal actions have occurred. The maximum sampled copper, cobalt, and arsenic concentrations along South Fork Big Deer Creek were 42,000 mg/kg, 1,600 mg/kg, and 820 mg/kg, respectively (see Table 5-5). The corresponding median concentrations were 7,450 mg/kg, 750 mg/kg, and 605 mg/kg. The samples with the highest concentrations were obtained from areas where copper precipitates were observed. Along Big Deer Creek, the maximum sampled copper and arsenic concentrations were 17,200 mg/kg and 268 mg/kg, respectively. The maximum sampled cobalt concentration along Big Deer Creek was 619 mg/kg in laboratory samples. Additional discussion of overbank deposits along South Fork Big Deer Creek is included in Section 5.3.4.

Blackbird Creek

Along Blackbird Creek, a number of overbank deposits were removed during 1999 Early Actions, and these areas were sampled for post-removal confirmation. Other areas were sampled in 1995, but have not yet been removed. In addition to the 1995 and 1999 sampling, extensive sampling was conducted in 2001 along Blackbird Creek downgradient of the mine in order to better characterize overbank deposits.

For overbank deposits in areas along Blackbird Creek where no removal has taken place, the maximum sampled concentrations for copper, cobalt, and arsenic were 41,000, 97,700, and 138,000 mg/kg, respectively (see Table 5-5). The corresponding median concentrations were 540, 750, and 2100 mg/kg. The relatively small median values (up to two orders of magnitude smaller than the corresponding maximum values) indicate that a large number of the sampled concentrations were significantly smaller than the maximum values.

Overbank deposits in areas along Blackbird Creek, where removal has taken place, had maximum sampled concentrations for copper and arsenic of 3,000 and 20,270 mg/kg, respectively. No results are available for cobalt. The corresponding median concentrations are 570 mg/kg and 970 mg/kg.

Panther Creek Inn

A major portion of the overbank deposits in the area of the Panther Creek Inn were removed during 1998. As originally planned, the overbank materials were excavated to a depth of approximately 1 foot. If visually obvious tailings materials were encountered at a depth greater than 1 foot, the excavation continued until native soils were encountered or until the water table was reached. Testing with the XRF instrument generally indicated that there were contaminated materials over most of the area at depth down to the water table. Thus, excavation generally proceeded to the water table throughout the Panther Creek Inn and associated campground areas.

Table 5-5 includes results of samples in areas where removal did not take place. For these samples, the maximum sampled copper, cobalt, and arsenic concentrations were 116, 94, and 64 mg/kg, respectively. Table 5-5 also includes post-removal sampling results in areas where removal occurred. The maximum sampled concentrations were 4,500 and 1,900 mg/kg for copper and arsenic, respectively (cobalt results were not reported since all results were below the XRF detection limit for cobalt). All the samples containing higher metal concentrations were collected at the water table and have been covered with a minimum of 1 foot of clean fill and topsoil.

Additional surface soil sampling was conducted in fall 2002 in the Panther Creek Inn area to characterize areas not removed during the Early Actions and to characterize areas that have been disturbed since the Early Actions. Additional risk evaluations will be conducted based on this sampling to determine if additional actions are required at the Panther Creek Inn area.

Panther Creek Downstream from Panther Creek Inn

Removal actions were conducted between 1999 and 2001 downstream from the Panther Creek Inn. These removal actions are summarized in Section 2 of this ROD. Removal actions along Panther Creek were conducted to meet preliminary removal goals (PRGs) established by EPA. Following removal, the backfilled soil was seeded with native vegetation or pasture grasses. The PRGs varied from 100 mg/kg arsenic for a residential exposure scenario to 590 mg/kg arsenic for a recreational exposure scenario.

In several cases, samples exceeding PRGs were not removed because removing them would have required significant alteration to the existing stream channel, would have caused significant damage to local vegetation, or would have adversely affected the stability of an adjacent soil slope. These samples were typically covered with a minimum of 12 inches of fill and topsoil and were then seeded.

The *Site-Wide Human Health Risk Assessment* concluded that the risks were acceptable under the current use scenario for the [redacted], [redacted], and [redacted] properties (see Figure 5-5 for the locations of these properties). No removals were conducted as part of the Early Actions at these properties. However, under the future residential scenario, the risks are estimated to be unacceptable for these areas (see Section 7.1 of this ROD). The overbank soil sampling results for these areas are summarized on Figures 5-6 through 5-9. Screening level sampling at the [redacted] property indicated that there may be unacceptable risks at this property. However, the sampling was not sufficient to adequately characterize the risks. Access for additional sampling on the [redacted] property has been denied by the property owner. Therefore, the EPA is unable to fully evaluate the risks for this property.

Contamination Remaining Along Panther Creek Following the Early Actions

During the Early Actions, the depth of excavation of soils at the removal areas at the PCI and along Panther Creek generally went either to the water table or the PRGs, whichever came first. Therefore, arsenic concentrations in some of the subsurface soils at the water table, below clean backfill, are higher than the site-specific PRGs established for each area. An evaluation was performed on the potential risks associated with exposure to the subsurface soils if they are brought to the surface in the future through such actions as utility trenching, fence post hole digging, or erosion. This evaluation involved comparing the arsenic concentrations measured in the post-removal subsurface samples against the site-specific PRG. The results of this evaluation are summarized below. A discussion of the need for Institutional Controls based on these results is provided in Section 12 of this ROD.

The following sites had no exceedances of their site-specific PRGs in the subsurface soils; therefore, there is essentially no risk that PRGs would be exceeded if the subsurface soils are brought to the surface in the future.

- Riprap Bar 6
- USFS Property adjacent to [redacted]
- [redacted] Middle Pasture Island
- Noranda Pasture 1

The following sites had some exceedances of the PRG in the post-removal subsurface soils; however, the average arsenic concentration in the subsurface soils was less than the PRG. In the event that subsurface soils are brought to the surface, in the vicinity of the disturbance it is unlikely that the average arsenic concentrations would be above the PRG.

- Riprap Bars 2 and 4
- [redacted] 2/2
- [redacted] Middle Pasture
- Napias 1A and 1B (private and USFS)

The following sites had exceedances of the PRG in the post-removal subsurface soils, and the average arsenic concentration in the subsurface soils was less than twice the PRGs. In the event that subsurface soils are brought to the surface, in the vicinity of the disturbance it is possible that the average arsenic concentrations would be above the PRG.

- Riprap Bar 1
- Deep Creek Campground 2
- [redacted] 2/1
- [redacted] 1 (Ditch Area)
- [redacted] Low Bar 2

- Noranda Pasture 3
- Cobalt 1, 4, and 5

Based on the post-removal sampling results, the following sites had exceedances of the PRG in the post-removal subsurface soils, and the average arsenic concentration in the subsurface soils was greater than twice the PRGs. In the event that subsurface soils are brought to the surface, in the vicinity of the disturbance it is likely that the average arsenic concentrations would be above the PRG.

- Panther Creek Inn area
- Riprap Bar 3 and 5
- (b) (6) Lower Pasture ((b) (6) 4/1 and 4/2)
- (b) (6) Upstream Low Bar
- (b) (6) Low Bar 1
- Noranda Pasture 2B
- Cobalt 2 and 3

5.4.3 Roads and Other Soils

A number of potentially mine impacted soil samples have been collected from areas that are not considered to be within waste rock dumps, debris flows, or overbank deposits. Table 5-6 summarizes available soils data for Panther Creek Road, the mine road in the Meadow Creek Basin, the mine road in the Bucktail Creek Basin, areas surrounding the waste-rock dumps, and in diversion ditches near the waste rock dumps. The respective maximum sampled arsenic concentrations are 67 mg/kg, 1,040 mg/kg, 2,430 mg/kg, 3,500 mg/kg, and 3,800 mg/kg. Corresponding median arsenic concentrations are 40 mg/kg, 702 mg/kg, 1,320 mg/kg, 310 mg/kg, and 75 mg/kg.

5.4.4 In-stream Sediments

In 1995, stream bottom sediments were sampled in Blackbird Creek, South Fork Big Deer Creek, Big Deer Creek, and Panther Creek. The purpose of the sediment sampling was to characterize metal concentrations in the different sediment types and to provide the basic information necessary to estimate the areal extent and mass of metals contained in stream bottom sediments. Forty-three sediment samples were analyzed for metals onsite by XRF. Metal analytes included As, Co, Cu, Fe, and Mn.

Sediment sampling was conducted again during 2000 and 2001 to provide information following completion of the Early Actions. Sampling was conducted in Panther Creek, Big Deer Creek, and South Fork Big Deer Creek at approximately half the locations that were sampled in 1995. Within Blackbird Creek, approximately one-quarter of the locations sampled in 1995 were sampled during 2000 and 2001. Sampling locations were spread throughout the entire length of each stream below potential mine impacts.

Table 5-7 compares sediment concentrations at locations that were sampled during both 1995 and 2000. Table 5-8 compares sediment concentrations at locations that were sampled during 2000 and 2001. A statistically valid comparison of pre-Early Action sediment values and post-Early Action sediment values is difficult because of the heterogeneity of the sediments and the variability from year to year due to downstream sediment transport. However, it appears that arsenic, copper and cobalt concentrations in sediments have generally been reduced since completion of the Early Actions.

Geochemical modeling was conducted to determine the potential for significant releases of metals to the water column in area streams. Except in the Bucktail Creek and the South Fork Big Deer Creek, it was determined that the potential for significant releases of metals from sediments was low. This is because the metals are mostly in the form of secondary minerals with strong adsorption to iron and manganese oxyhydroxides in the sediments. Desorption from iron and manganese oxyhydroxides in Big Deer and Panther Creeks may result in some trace metal loading. However, desorption profiles are generally smooth indicating a very slow release of metals as a new equilibrium is reached between the aqueous and adsorbed phases. The observed decrease in total sediment metal concentrations between pre and post-Early Action sediment data may be attributable to physical sediment transport, that is to say, the scouring and mobilization of fine-grained sediments downstream combined with reduced loading to the sediments as a result of improvements in water quality.

There are metals in the in-stream sediments and adjacent overbank deposits (including debris flow deposits) along Bucktail Creek. Most of these metals are in the form of copper carbonates which have been deposited in the past. These copper carbonates can be comparatively easily re-dissolved and re-mobilized under conditions of reduced metals concentrations in the overlying water column. If the copper concentrations in Bucktail Creek waters are substantially reduced, it is likely that the copper carbonates in the sediments will re-dissolve and be released to the surface waters. In addition, the copper carbonates in the overbank deposits are likely to be easily re-dissolved and flushed into Bucktail Creek during rainfall and/or snowmelt. The amount and duration of the potential releases from the Bucktail Creek sediments and overbank deposits is not known. Downstream from the lower Sediment Dam, there are deposits of debris flow materials along the old channels of Bucktail Creek. Limited sampling in these materials indicates elevated concentrations of metals. The amount and duration of potential releases from these debris flow deposits is not known.

In South Fork Big Deer Creek, trace metal release from sediments is believed to be primarily responsible for the current observed increases in copper and sulfate concentrations between SFSW-02 and SFSW-01. Copper carbonate dissolution is believed to be the primary mechanism responsible for dissolved copper loading. Sulfate loading is likely the result of desorption or sulfate mineral dissolution. There is also evidence of copper carbonate deposits in the overbank areas adjacent to the South Fork Big Deer Creek (ex. historic stream channels), which could be readily re-dissolved and flushed into South Fork Big Deer Creek during rainfall and/or snowmelt. The amount and duration of potential releases from these overbank deposits is not known.

5.4.5 Surface Waters

The surface waters at the Site were sampled at different times of the year using a variety of methodologies to characterize the variations in water quality. The surface water sampling results summarized below include only data collected since the completion of the Early Actions. The primary purpose of the surface water sampling was to determine the remaining sources of metals loading that need to be addressed through remedial actions. The surface water sampling included diel sampling, periodic sampling, storm sampling, and synoptic sampling. The sampling locations are shown on Figure 5-4.

5.4.5.1 Diel Sampling Results

Diel sampling was conducted over a 24-hour period in both the Blackbird Creek basin and in the Big Deer Creek basin during spring runoff to determine if there were significant variations in water quality during the day.

Diel sampling was conducted at the mouth of Blackbird Creek (BBSW-01A) on April 30 and May 1, 1998. There was almost no variation in total or dissolved cobalt and dissolved copper concentrations. There was an increase in total copper that lasted from about 6:00 p.m. to midnight on April 30. By 8:00 a.m. on May 1, the total copper returned to concentrations comparable to the beginning of the sampling period even though flows were significantly higher. The highest total copper concentrations were apparently associated with an increase in turbidity and total suspended solids that corresponded with the increasing flows for the samples collected between 6:00 p.m. and midnight.

A round of diel sampling was conducted in the Big Deer Creek drainage at stations SFSW-04, SFSW-01, BDSW-04, and BDSW-03 from May 23 to May 24, 2000. The May 23/24 diel sampling was conducted during peak seasonal flow on Big Deer Creek (as measured at BDSW-03) and just prior to peak flows on South Fork Big Deer Creek (measured at SFSW-01). Though slight variations in metals concentrations and loading were observed during the event, no conclusive diel variation was observed. The observed runoff during this sampling event did not follow an "ideal" diel pattern of flow increases that correspond to melt during the day followed by flow decreases that result from cooler night temperature.

5.4.5.2 Periodic Sampling Results

Post-Early Action water quality sampling was conducted periodically at selected stations during spring runoff to evaluate variability (i.e., rising and falling limbs of the hydrograph) and to identify periods of maximum concentrations and loading. This section summarizes results from selected stations.

In Blackbird Creek, weekly sampling was conducted at BBSW-01A, which is located near the mouth of Blackbird Creek, between March 27 and June 2, 2000. Between April and late May, flow in Blackbird Creek generally increased as the result of snowmelt runoff. From late May to early June, flow generally decreased. Cobalt concentrations generally declined as flow increased. This is an indication that base flow discharges from the West Fork Tailings Impoundment are the likely source of much of the cobalt loading observed. These discharges are diluted by snowmelt runoff resulting in higher flows. Copper behavior was observed to be different than that of cobalt. Copper concentrations generally increased as flow increased between late March and mid-May. Copper concentrations then declined as flow declined.

Samples were also collected weekly at Panther Creek stations PASW-10, PASW-11, PASW-09, PASW-04 and PASW-05 (March 27 to June 2, 2000). In general, cobalt and copper concentrations followed the same trends as those observed at BBSW-01A. Weekly samples were also collected during the 1999 spring runoff at BBSW-01A, PASW-10 and PASW-04. In general, the 1999 results were similar to those described for the 2000 weekly sampling.

Sampling was conducted intermittently from April 6 through May 24, 2000 (six sampling events) at the following stations in the Big Deer Creek drainage basin: SFSW-04, SFSW-01, BDSW-04, and BDSW-03. Panther Creek stations PASW-05 and PASW-04 were also sampled in conjunction with periodic sampling on Big Deer and South Fork Big Deer creeks. Stations SFSW-04 and BDSW-04 are the background stations for South Fork Big Deer and Big Deer Creeks, respectively. Downstream stations SFSW-01, BDSW-04 and PASW-04 exhibited similar trends over this period. At all three stations, increases in copper and cobalt loading were observed with increases in flow.

Intermittent periodic sampling was also conducted in 1999 at several of the stations in the Big Deer Creek drainage basin. However, there were only three sampling events, and not all stations were sampled during each event. Therefore, the results of this periodic sampling were inconclusive.

Periodic sampling was conducted monthly at BBSW-01A and PASW-9 during 2001 and 2002 to better define the variations in cobalt concentrations throughout the year. The results of this sampling are included in Table 5-9. In general, cobalt concentrations in Blackbird and Panther Creeks peak during the winter and early spring. The concentrations decrease with increasing flows during spring runoff, then slowly begin increasing again as flows decrease following spring runoff.

5.4.5.3 Storm Sampling Results

Storm event sampling was conducted to evaluate metals loading during and immediately following storm events. In 1998, two storm events in the Blackbird drainage (June and September) were sampled. Samples for these storm events were collected manually at BBSW-07, BBSW-03A and BBSW-01A. Results of this sampling were inconclusive. Therefore, in 1999, flow-actuated automated samplers were installed at BBSW-01A and SFSW-01 to capture storm events in the Blackbird and Bucktail drainages, respectively.

On August 28, 1999, a storm event in the Blackbird drainage triggered the automatic sampler at BBSW-01A. The August 28, 1999 storm was likely typical of a small summer storm. Sampling began during the initial peak in streamflow. Analytical results indicated an increase in dissolved copper, cobalt and manganese concentrations of between 70% and 260% in comparison to the most recent sampling event prior to the storm. Maximum total metals loading rates (calculated as daily load) were 13.4 kg/day cobalt, 6.97 kg/day copper and 6.56 kg/day manganese. Tailings removal was occurring along Blackbird Creek immediately prior to this storm event. Observed loading during this storm are likely partially attributable to flushing of sediments disturbed during tailings removal. Loading rates for both total and dissolved metals as a result of the storm event were considerably less than the loading during the spring 1999 runoff.

There were no storm events that triggered the automated samplers in the Bucktail Creek drainage in 1999 or 2000. The storm samplers were able to capture a storm event on July 30-31, 2001. Samples were collected at three stations: BTSW-02, BTSW-01.1, and SFSW-01. Precipitation during this storm event was 0.6 inches over a 24-hour period, which represents a small to moderate storm event.

Due to a sampler failure, total metals data are not available at BTSW-02 (just downstream from the upper sediment dam). Dissolved metals did not show significant variability at this station during the storm.

At station BTSW-01.1 (just upstream from the lower sediment pond in the Bucktail Creek drainage), a large increase in total copper concentration was observed (from 1.25 to 7.03 mg/L) approximately two hours after the beginning of the storm. The large increase in total copper concentrations was likely due to the scouring of sediments high in copper carbonates due to the increase in stream flows. The total copper concentrations slowly decreased until reaching pre-storm concentrations at the end of the storm event. Overall, dissolved copper concentrations, total cobalt concentrations, and dissolved cobalt concentrations remained relatively stable at this station throughout the storm event.

In the Bucktail Creek drainage, both dissolved and total copper and cobalt concentrations at downstream station SFSW-01 remained fairly stable throughout the storm event. The large increase in total copper concentrations seen at BTSW-01.1 was not observed at SFSW-01, probably due to settling of suspended sediments high in copper carbonates in the lower sediment pond. A gradual increase in total copper was observed during the course of the storm event, from 0.098 to 0.153 mg/L. Dissolved copper also increased slightly during the storm event, from 0.086 mg/L to 0.093 mg/L. These concentrations are comparable to the spring synoptic dissolved copper concentration of 0.080 mg/L and the fall synoptic concentration of 0.092 mg/L. Dissolved cobalt exhibited a slight increase during the storm event, from 0.104 to 0.124 mg/L.

5.3.5.4 Synoptic Sampling Results

Synoptic sampling was conducted during the rising limb of the snowmelt runoff hydrograph and during base flow conditions to determine the remaining sources of metals loading. In synoptic sampling, an attempt is made to sample the same parcel of water as it moves downstream. Synoptic sampling is conducted by collecting the first sample at the most upstream point of interest on the stream and then sampling the downstream stations sequentially while taking into account the travel time of the water based on flow velocity. Sampling in this manner allowed comparison between specific reaches of the stream to determine whether the stream between the stations is a gaining or losing reach in terms of both flow and metals loading.

Spring and fall synoptic sampling were conducted to characterize post-Early Action conditions in the Meadow/Blackbird Creek basin in each year from 1998 through 2001. Because Early Actions were not completed in the Bucktail/Big Deer Creek basin until 1998, the spring and fall synoptic sampling was conducted from 1999 through 2001. While there was variability among the years, primarily due to changing hydrologic conditions, the synoptic sampling results were fairly consistent from year to year. The synoptic sampling results for the spring and fall 2000 sampling events are most representative of the period of sampling and are discussed below. Complete results of all synoptic sampling events are included in the RI and the Addendum to the RI.

Meadow/Blackbird Creek Spring Synoptic Sampling

Results for the Meadow Creek spring synoptic sampling for 2000 for copper and cobalt are presented on Figures 5-10 and 5-11. Between locations MCSW-EA04.35 and MCSW-EA04, a significant increase in copper loading was observed. Concentrations of dissolved copper increased from 0.039 mg/L to 3.62 mg/L, and total copper increased from 0.048 mg/L to 3.73 mg/L. Dissolved cobalt concentrations increased in a similar manner from 0.155 mg/L to 1.510 mg/L. These increases are likely due to ground and surface water passing through a debris deposit near the foot of the 7800 Waste Rock Dump, and then entering Meadow Creek via the 7100 West Diversion System. These waters bypass the 7800 Collection System.

Blackbird Creek spring synoptic sampling results for 2000 for copper and cobalt are provided on Figures 5-12 and 5-13. Similar results were obtained during the spring synoptic sampling in 1999 and 2001. Cumulative loading from the Meadow Creek/Upper Blackbird Creek area is best measured at station BBSW-07A. Dissolved copper and cobalt loading at station BBSW-07A were 1.64 kg/day, with a corresponding concentration of 0.447 mg/L, and 1.42 kg/day, with a corresponding concentration of 0.387 mg/L, respectively. Total copper and cobalt loads were 4.70 kg/day, with a corresponding concentration of 1.280 mg/L, and 1.46 kg/day, with a corresponding concentration of 0.398 mg/L.

When compared to station BBSW-07A, at BBSW-07 concentrations of dissolved copper declined (from 0.447 mg/L to 0.260 mg/L). Although concentrations declined, dissolved loading increased during increasing flow to 2.41 kg/day. Total copper loading increased to 8.06 kg/day, with a corresponding concentration of 0.867 mg/L. Dissolved and total cobalt concentrations and loading increased between stations BBSW-07A and BBSW-07, primarily as a result of wastewater treatment plant discharges (0.935 mg/L dissolved cobalt). Dissolved cobalt was 0.387 mg/L at BBSW-07A and 0.782 mg/L at BBSW-07. Loading increased from 1.42 kg/day at BBSW-07A to 7.27 kg/day at BBSW-07, of which 4.2 kg/day was contributed by the wastewater treatment plant discharge. Dissolved and total copper concentrations and loading generally decreased along Blackbird Creek downstream of BBSW-07, whereas cobalt concentrations decreased but loading increased.

Downstream of BBSW-07, concentrations of dissolved copper generally declined to the mouth of Blackbird Creek, with the exception of an increase between stations BBSW-02 (0.050 mg/L) and BBSW-01.5 (0.054 mg/L). Dissolved copper concentrations decline overall between stations BBSW-07 and BBSW-01A from 0.260 mg/L to 0.044 mg/L, respectively, with load following a similar trend decreasing from 2.41 kg/day to 1.42 kg/day.

Overall, dissolved cobalt concentrations declined between BBSW-07 and BBSW-01A, from 0.782 mg/L to 0.387 mg/L. However, there are some areas of increased cobalt loading. A small amount of cobalt loading (0.59 kg/day, with a corresponding concentration decrease of 0.021 mg/L) was observed between BBSW-07 and BBSW-06. A load increase between BBSW-03A and BBSW-02 of 7.09 kg/day (with a corresponding concentration decrease of 0.09 mg/L) was measured, with most of the loading attributable to discharges from the West Fork Tailings Impoundment area.

Meadow/Blackbird Creek Fall Synoptic Sampling

The results of the fall 2000 synoptic sampling for copper and cobalt on the Meadow Creek drainage are presented on Figures 5-14 and 5-15. As in the spring, an increase in copper concentration and loading was observed between locations MCSW-EA04.35 and MCSW-EA04. Concentrations of dissolved copper increased from 0.020 mg/L to 0.815 mg/L, and total copper increased from 0.023 mg/L to 1.05 mg/L. Dissolved cobalt concentrations increased in a similar manner from 0.118 mg/L to 0.822 mg/L. These results are similar to the spring results, suggesting there is likely a source of metals loading between these locations, which is likely debris-flow materials below the 7800 Waste Rock Dump and/or seepage that is not being collected for treatment by the 7800 Collection System.

The dissolved copper loading in the Meadow Creek basin during the fall 2000 sampling event was significantly lower than that observed during the spring synoptic event. The dissolved copper concentration was 0.815 mg/L and loading was 0.06 kg/day at MCSW-04. Dissolved cobalt was 0.822 mg/L and loading was 0.06 kg/day at this station. Although flow increased from 0.03 cfs to 0.04 cfs, dissolved copper and cobalt concentrations and loading decreased to 0.436 mg/L and 0.043 kg/day copper and 0.472 mg/L and 0.0463 kg/day cobalt at the 7100 Bypass, which is the next station downstream of MCSW-04. Station MCSW-03 and other discharge points along Meadow Creek were dry during the fall round; therefore, loading results from the 7100 Bypass represent all loading from the Meadow Creek drainage. Dissolved and total copper loading decreased between the 7100 Bypass and BBSW-07A and cobalt remained relatively unchanged. This suggests there is no additional source of metals loading downstream of the upper Meadow Creek basin and that copper may be precipitating/sorbing in the concrete channel.

The synoptic sampling results for fall 2000 for the Blackbird drainage are presented on Figures 5-16 and 5-17. Similar results were obtained during the fall synoptic sampling in 1999 and 2001. The dissolved copper concentration at BBSW-07 increased to 0.183 mg/L and loading was 0.23 kg/day. Dissolved cobalt was 0.193 mg/L and loading was 0.246 kg/day. Flow increased from 0.4 cfs to 0.52 cfs between stations BBSW-07A and BBSW-07. This increase in flow and metals concentrations and loading downstream of BBSW-07A may be due to groundwater discharges.

Between stations BBSW-07 and BBSW-01A, upstream of the mouth of Blackbird Creek, dissolved copper concentrations and loading declined, with dissolved copper concentration at BBSW-01A of 0.010 mg/L and loading of 0.058 kg/day. Minor inputs of copper between these stations during the fall sampling event included the cumulative groundwater input of the West Fork Tailings Impoundment, which showed an increase in dissolved copper loading from 0.140 kg/day at BBSW-03A to 0.192 kg/day at BBSW-02, although dissolved copper concentrations decreased from 0.063 mg/L to 0.044 mg/L. Downstream of BBSW-02, as noted for other sampling events, dissolved copper was converted to total copper and co-precipitated with iron oxides, resulting in a decrease in copper concentrations downstream of the West Fork Tailings Impoundment.

Dissolved cobalt concentrations downstream of BBSW-07 increased to 0.298 mg/L at BBSW-03A, which is attributable to discharges from several seeps including: BBSP-11/11A, BBSP-03, BBSP-09, and BBSP-27 containing cobalt ranging from 0.453 mg/L to 1.11 mg/L cobalt. Between stations BBSW-03A and BBSW-02, increased concentrations and loading were observed for cobalt, sulfate, iron and manganese as a result of discharges from the West Fork Tailings Impoundment. Cobalt concentrations increased to 0.878 mg/L with a load increase of 3.16 kg/day from BBSW-03A to BBSW-02.

Bucktail/Big Deer Creek Spring Synoptic Sampling

In the summer of 2000 significant portions of the vegetation in Bucktail/Big Deer Creek basins were burned in the Clear Creek fire. The effects of this have resulted in a marked loss of evapro-transpiration from the larger old growth deep-rooted forest and a faster spring and storm runoff.

The spring 2000 synoptic sampling results in the Bucktail/Big Deer Creek basin for copper and cobalt are presented in Figures 5-18 and 5-19. Results were similar during the 1999 and 2001 synoptic sampling events.

The uppermost sampling locations on Bucktail Creek were two adjacent seeps that discharge into the Upper Sediment Pond, designated BTSW-03A and BTSW-03B. These samples represent seepage below the 7000 Dam on upper Bucktail Creek.

The cumulative flow from these seeps was 0.03 cfs, providing a measured cumulative dissolved copper load of 0.61 kg/day, with a corresponding combined concentration of 20.4 mg/L, above the Upper Sediment Pond. Copper loading increased between these locations and location BTSW-02 to 0.92 kg/day, with a corresponding concentration of 23.40 mg/L, indicating that groundwater containing copper in higher concentrations is discharging between the locations. Other metals showed similar increases in concentration and loading between these locations.

Water quality at BTSW-02 is used to assess the effectiveness of all Early Actions in upper Bucktail Creek. Dissolved copper concentration was 23.4 mg/L and loading was 0.92 kg/day in 2000, compared to13.8 mg/L and 6.08 kg/day in 1999. Dissolved cobalt was 6.42 mg/L with a load of 0.25 kg/day in 2000, compared to 1999 results (4.43 mg/L and 1.95 kg/day). These represent significant load reductions for both copper and cobalt. Remaining loading is likely either due to leakage from the 7000 Dam or groundwater discharges to Bucktail Creek.

Between BTSW-02 and BTSW-01.6, dissolved copper loading nearly triples from 0.91 kg/day to 2.69 kg/day due to increased flow. The dissolved copper concentration was significantly lower at BTSW-01.6 (12.5 mg/L) than at BTSW-02 (23.4 mg/L). Dissolved and total cobalt concentrations at BTSW-1.6 were 4.44 mg/L and 3.86 mg/L, respectively, with corresponding loading of 0.96 kg/day and 0.83 kg/day. BTSP-01 accounts for 0.43 kg/day of the dissolved copper loading (19.6 mg/L of the dissolved copper concentration) and 0.13 kg/day of the dissolved cobalt loading (5.71 mg/L of the dissolved cobalt concentration). Between stations BTSW-01.6 and BTSW-01.4, metals concentrations and loading decline significantly due to mineral precipitation.

Loading results at BTSW-01 are used to assess the effectiveness of all Early Actions in the upper and lower portions of the Bucktail Creek drainage. Dissolved copper was 1.12 mg/L with loading of 0.38 kg/day, showing a decrease since 1999 when concentrations were 4.68 mg/L and loading was 8.8 kg/day. As observed in past years, copper precipitation is probably the mechanism for continued declines from upstream stations. Dissolved cobalt concentration was 1.54 mg/L with loading of 0.9 kg/day.

SFSW-02 is located downstream of the confluence with Bucktail Creek. Dissolved copper was 0.088 mg/L with a load of 0.52 kg/day. Dissolved cobalt was 0.08 mg/L with a load of 0.51 kg/day. At station SFSW-01 at the mouth of South Fork Big Deer Creek, the concentration of dissolved copper increased to 0.129 mg/L from 0.088 mg/L at SFSW-02.

BDSW-03 is downstream of the confluence of South Fork Big Deer Creek. The dissolved copper concentration was 0.006 mg/L and loading at this station was 0.62 kg/day. The dissolved cobalt concentration was 0.006 mg/L with a load of 0.62 kg/day.

During the spring 2002 synoptic sampling, there was a significant increase in dissolved copper concentration between BDSW-03 and BDSW-01 (from 0.011 to 0.023 mg/L). Flows were not measured at BDSW-01 during the spring 2002 sampling, thus loads cannot be calculated. This increase in dissolved copper in Big Deer Creek had not been observed during previous synoptic sampling. Because this increase in dissolved copper concentrations may indicate a previously unidentified loading source, more detailed synoptic sampling in Big Deer Creek was conducted during fall 2002, and will be conducted during the spring 2003 synoptic sampling. If this more detailed synoptic sampling indicates significant metals sources along Big Deer Creek, contingency measures will be evaluated to address these sources.

PASW-04 is located in Panther Creek downstream of the confluence with Big Deer Creek and was sampled during the Bucktail synoptic sampling event. Dissolved copper concentration was 0.006 mg/L and dissolved cobalt was 0.019 mg/L. Concentrations of these metals in PASW-05, which is located upstream of Big Deer Creek, were the same for copper and dissolved cobalt was 0.020 mg/L. On this date, Panther Creek streamflow was measured at 297 cfs, giving loading for dissolved copper at 4.36 kg/day and dissolved cobalt at 13.83 kg/day.

Bucktail/Big Deer Creek Fall Synoptic Sampling

The results of the fall 2000 synoptic sampling in the Bucktail/Big Deer Creek basin for copper and cobalt are presented on Figures 5-20 and 5-21. Results were similar during the 1999 and 2001 synoptic sampling events.

As in the spring, the West Fork of Bucktail Creek, which typically has been the uppermost location sampled during the Bucktail synoptic sampling event, was dry. Therefore, the uppermost sampling locations were two adjacent seeps, designated BTSW-03A and

BTSW-03B, that discharge into the Upper Sediment Pond. Dissolved copper concentrations were 10.1 mg/L at BTSW-03A, and 3.7 mg/L at BTSW-03B, and cobalt was 3.74 mg/L and 2.25 mg/L, respectively. Cumulative dissolved copper loading was 0.06 kg/day and dissolved cobalt loading was 0.03 kg/day, total copper and cobalt loading for these seeps was 0.07 kg/day and 0.03 kg/day respectively.

Dissolved copper loading increases between BTSW-03 and BTSW-01.6. The increase in loading was 1.82 kg/day. Along this reach, BTSP-01 contributes significant copper loading (17.5 mg/L and 0.381 kg/day). Between BTSW-01.6 and BTSW-01.4, both dissolved and total copper concentrations and loads declined by 89% and 58% and 48% and 54%, respectively. The proportionally greater decline in dissolved copper is attributed to the precipitation of copper minerals.

Between stations BTSW-03A/BTSW-03B and BTSW-01.6, dissolved cobalt concentrations decreased by 2.95 mg/L and loading increased by 0.63 kg/day. Between BTSW-01.6 and BTSW-01, copper and cobalt concentrations and loading decline. The ratio of dissolved load to total load for copper and cobalt all also decline, indicating these constituents are participating in either mineral precipitation or adsorption reactions. Concentrations at BTSW-01 were 0.492 mg/L (dissolved copper), 1.20 mg/L (dissolved cobalt), 0.18 mg/L (dissolved manganese) and 148 mg/L (sulfate).

Between SFSW-02 and SFSW-01, dissolved copper loading increased from 0.173 kg/day to 0.285 kg/day with an increase in concentration from 0.058 mg/L to 0.104 mg/L. Total copper loading increased from 0.19 kg/day to 0.31 kg/day. Total and dissolved cobalt had similar load and concentrations between these stations.

The dissolved copper concentration at BDSW-03 was 0.021 mg/L with a measured load of 0.359 kg/day. Dissolved cobalt concentration was 0.011 mg/L and loading was 0.19 kg/day. At PASW-05 located upstream of Big Deer Creek, dissolved copper was not detected (Detection limit = 0.003 mg/L). At PASW-04, downstream of Big Deer Creek, the dissolved copper concentration was also below detectable limits. Dissolved cobalt was 0.026 mg/L in PASW-05 and 0.023 mg/L in PASW-04.

Panther Creek Spring Synoptic Sampling

A round of synoptic sampling was conducted during spring 2000 at Panther Creek stations PASW-11, PASW-10, PASW-09.5, PASW-09, and PASW-08A. The purpose of this sampling was to determine whether there were any increases in loading through the area of the Cobalt Townsite and Noranda Pasture property which may be attributed to metal release from sediments or overbank deposits. Results are presented on Figures 5-22 and 5-23.

Station PASW-11 characterizes water quality in Panther Creek prior to inputs from Blackbird Creek. At PASW-11, Panther Creek metals results were below detectable limits for copper and cobalt and total and dissolved manganese concentrations were 0.003 and 0.004 mg/L, respectively.

Station PASW-10 is located downstream of the confluence of Blackbird Creek and Panther Creek. Dissolved copper concentration at PASW-10 was 0.005 mg/L, with a load of 1.24 kg/day, and dissolved cobalt was 0.056 mg/L with a load of 13.8 kg/day. At PASW-9.5, located upstream of the Cobalt town site, the dissolved copper concentration was 0.020 mg/L and cobalt was 0.060 mg/L. This represents a slight increase in cobalt concentration from station PASW-10, and a significant increase in copper concentration.

At PASW-9, concentrations of dissolved copper and cobalt were 0.007 mg/L and 0.053 mg/L, respectively, with corresponding loading of 1.68 kg/day dissolved copper and 12.7 kg/day cobalt. Dissolved manganese results decreased slightly from 0.039 mg/L at PASW-9.5 to 0.038 mg/L.

At PASW-8A, concentrations of dissolved copper increased slightly from station PASW-9 to 0.010 mg/L and cobalt concentrations remained at 0.053 mg/L. A lower flow was measured at PASW-8A, resulting in a lower load for cobalt of 11.3 kg/day. Dissolved copper concentration and loading increased from 0.007 mg/L and 1.67 kg/day to 0.010 mg/L and 2.13 kg/day between these stations. The decrease in flow between station PASW-09 and PASW-08A suggests this is a losing reach. Flow decreased between these stations from 97.9 cfs to 87.1 cfs in 2000.

Panther Creek Fall Synoptic Sampling

Panther Creek stations PASW-11, PASW-9.5, PASW-09, and PASW-08A were sampled during the fall 2000. Concentrations and loading results for copper and cobalt in Panther Creek are presented on Figures 5-24 and 5-25.

Loading calculations between PASW-11 and PASW-8A were conducted to study possible metal loading from overbank deposits. As seen during previous sampling sessions, during the fall synoptic sampling, a flow decrease from 38.3 cfs at PASW-9.5 to 29.6 cfs at PASW-8A was recorded. Dissolved copper concentrations were less than the detection limit (0.003 mg/L) at all stations. Cobalt concentrations at these stations varied from 0.053 mg/L (PASW-9.5) to 0.055 mg/L (PASW-08A).

Synoptic sampling conducted in the reach of Panther Creek between PASW-11 and PASW-8A during several other years during both spring and fall conditions proved inconclusive. Aside from the slight variations in flow between stations, there is no significant change in metals loading in this reach, indicating that there is no source for metals contribution in this reach.

5.4.6 Background

During the RI, background samples were collected for surface water, in-stream sediments, and soils. The background sampling is summarized below.

5.4.6.1 Surface Water

Background surface water samples were collected at several reference stations at area creeks. The background stations include:

- PASW-11: Panther Creek upstream from Blackbird Creek
- BBSW-08: Blackbird Creek upstream from the Clean Water Reservoir
- SFSW-03: South Fork of Big Deer Creek upstream from Bucktail Creek
- SFSW-04: South Fork of Big Deer Creek upstream from SFSW-03. The background station for South Fork Big Deer Creek was moved upstream in 2000 to avoid possible influences from the spillway at the lower Sediment Dam
- BDSW-04: Big Deer Creek upstream from the South Fork Big Deer Creek
- ICSW-01: Indian Creek (a tributary to Big Deer Creek)
- EFBTSW-01: East Fork of Bucktail Creek
- WFSW-02.5: West Fork Blackbird Creek upstream from the West Fork Tailings Dam

The concentrations of cobalt, copper and iron measured at these background stations are summarized in Table 5-10. Concentrations of dissolved cobalt ranged from non-detect to 0.007 mg/L, concentrations of dissolved copper ranged from non-detect to 0.02 mg/L, and concentrations of dissolved iron ranged from non-detect to 0.9 mg/L. Values greater than the detection limit for dissolved copper were recorded in spring 1999 in the QA/QC equipment blank samples. Additional QA/QC efforts were employed after the anomalous results of 1999 and to date dissolved copper at these locations since 1999 has remained at or below the detection limit.

5.4.6.2 In-stream Sediments

Background samples for in-stream sediments were collected at stations PASW-11, BBSW-08, SFSW-04, and BDSW-04. In addition, sediment data collected by Bennett in 1977 and the USGS in 2001 were also reviewed in determining background for in-stream sediments. The samples collected by Bennett and the USGS indicated the presence of naturally occurring metals in some of the creeks in the vicinity of the Blackbird Mine. Appendix B of the Aquatic Ecological Risk Assessment includes an evaluation of these data to develop a 95 percent upper tolerance level (UTL) for arsenic, cobalt, copper and iron for in-stream sediments. Different 95 percent UTLs were developed for in-stream sediments in areas that were considered to be mineralized and for in-stream sediments in areas that were considered to be non-mineralized. The 95 percent UTLs are summarized in Table 5-11. The 95 percent UTLs for mineralized areas were considered to be applicable to Blackbird Creek, Bucktail Creek, and South Fork Big Deer Creek. The 95 percent UTLs for non-mineralized areas were considered to be applicable to Big Deer Creek and Panther Creek.

5.4.6.3 Soils

Background soils data were collected by several entities prior to the RI. These background soils data are summarized in Table 5-12. The background concentrations of arsenic, cobalt, and copper from these data ranged from <5 to 900, <5 to 700, and 4 to 2400 mg/kg, respectively. Background soils data were also collected for the RI. These data are summarized in Table 5-13. The background concentrations of arsenic, cobalt, and copper from these data ranged from 4.9 to 637.5, 4 to 314, and 9.7 to 1425 mg/kg, respectively. The higher concentrations of arsenic, cobalt, and copper in soils generally represent background samples collected at the Blackbird Mine and at other mineralized areas in the vicinity. Statistical analyses were not conducted on these data to develop the 95 percent UTL for background soils concentrations.

Arsenic is the primary contaminant of concern in terms of human contact with soils. As part of the human health risk assessment process, a 95 percent UTL background value for arsenic in soils was developed. Soil samples were evaluated from the background data set that had been collected for the RI and also for the Early Actions. The areas represented in this arsenic background data set primarily represent riparian areas and areas along Panther Creek that have not been impacted by mining or mining related activities. The areas along Panther Creek were the focus of this data set because these areas include the primary public use areas in the vicinity of the Blackbird Mine. Three data sets were included in the evaluation of the 95 percent UTL for arsenic background in soils:

- Thirty seven samples collected from borrow areas at the Cobalt Townsite

- Nine samples collected during 1998 overbank sampling along Panther Creek

- Five samples collected in 1995 from riparian areas near Blackbird Creek and Panther Creek

The background data used for calculating the 95 percent UTL for arsenic in soils are summarized in Table 5-14. A statistical analysis of these data was performed in the Human

Health Risk Assessment for Panther Creek Overbank Deposit Areas. This analysis indicated that the background level for arsenic in riparian soils and in areas along Panther Creek is 100 mg/kg.

5.4.7 Remaining Sources of Metals Loading

The results of all of the surface water sampling were analyzed to determine the significant sources of post-Early Action metals loading. This analysis was primarily based on the synoptic sampling because this allows comparison between specific reaches of the streams to determine whether the stream between stations is a gaining or losing reach in terms of both flow and metals loading.

The remaining significant metals sources to Meadow Creek, Blackbird Creek and Panther Creek downstream of Blackbird Creek include:

- *Meadow Creek Waste Rock.* Seepage from below the 7800 waste rock dump and debris flow materials, which is bypassing the collection system and is not being collected for treatment, is a source of residual copper loading during spring runoff. During the spring 2000 synoptic sampling event, this area (measured at the 7100 bypass) contributed 2.85 kg/day of copper. Areas where waste rock was removed from the east side of Meadow Creek contributed 0.25 kg/day of copper during the Blackbird spring synoptic sampling event. Waste rock in Meadow Creek does not contribute a significant amount of cobalt loading (< 1 kg/day), nor does it contribute significant copper loading (0.04 kg/day) during low flow conditions.

- *Wastewater Treatment Plant Discharge.* The water treatment plant discharge is an insignificant source of dissolved copper loading (<0.08 kg/day during spring 2000 sampling). The wastewater treatment plant contributed 4.2 kg/day of dissolved cobalt to Blackbird Creek during the 2000 spring synoptic sampling event, which was 30% of the dissolved cobalt loading at the mouth of Blackbird Creek (BBSW-01A). Changes were made to the operating mode of the treatment plant in 2000 that significantly improved the removal efficiencies for cobalt. The wastewater treatment plant is no longer a significant cobalt loader to Blackbird Creek. During the spring 2001 synoptic sampling event, the wastewater treatment plant contributed 0.2 kg/day of dissolved cobalt to Blackbird Creek, which represented less than 2 percent of the dissolved cobalt loads at the mouth of Blackbird Creek.

- *Hawkeye Gulch.* Hawkeye Gulch surface water runoff contributes an insignificant percentage of the dissolved copper (4%) and dissolved cobalt load (1%) measured at BBSW-07 during spring runoff. Hawkeye Gulch is dry during low flow conditions.

- *Groundwater discharge in upper Blackbird Creek downstream of the cutoff wall.* It appears that groundwater discharges to upper Blackbird Creek may have contributed a small amount of copper and cobalt, as evidenced by the unaccounted increase in loading between BBSW-07A and BBSW-07 during 2000 sampling. During the 2000 Spring synoptic sampling event there was an unaccounted load increase of about 0.6 kg/day of dissolved copper and 1.54 kg/day of cobalt, representing 25% of the dissolved copper load and 21% of the dissolved cobalt load at BBSW-07. During the fall of 2000, the unaccounted load increase was about 0.2 kg/day for both copper and cobalt, representing 88% of the dissolved copper load and 93% of the dissolved cobalt load at BBSW-07. The seeps and other loading sources in upper Blackbird Creek and Meadow Creek that contribute load during the spring are mainly dry at low flow. During 2001, a blockage of the pipeline that collects groundwater upstream of the cutoff wall was discovered. This blockage caused head to build up behind the wall and seepage to occur around a pipe which had not been sealed properly where it exited the manhole upstream of the cutoff wall. It is likely that this blockage contributed to loading that was observed at BBSW-07 during 2000. The blockage was removed and a seal was installed around the pipe prior to conducting the 2001 spring synoptic sampling. During the 2001 spring synoptic sampling event, the unaccounted dissolved copper load at BBSW-07 was 0.37 kg/day (15% of the load at BBSW-07) and the dissolved cobalt load was 0.2 kg/day (10% of the load at BBSW-07). During low flow conditions in 2001, the unaccounted load increase between BBSW-07A and BBSW-07 was 0.19 kg/day for dissolved copper (83% of the load measured at BBSW-07) and the unaccounted dissolved cobalt load was 0.2 kg/day (80% of the load at BBSW-07). During spring 2002, significant seepage was observed entering the Blackbird Creek channel upstream from the cutoff wall. This seepage was due to high groundwater in this vicinity. During June 2002, the BMSG constructed additional groundwater drains adjacent to the channel upstream from the cutoff wall to intercept this water for treatment at the water treatment plant. These additional drains should reduce the metals loads that have been previously observed in this stretch of Blackbird Creek.

- *Seeps BBSP-03, 09, and 45 discharging to Blackbird Creek between BBSW-04 and BBSW-03.* These seeps contributed a combined 0.63 kg/day of dissolved copper and 1.43 kg/day of cobalt during the Spring 2000 synoptic round of sampling. However, copper precipitation is also occurring in this reach as concentrations decrease and there was a net loss of copper between stations BBSW-04 and BBSW-03 when all measured sources are counted. Discharges from these seeps were minimal (less than 0.1 kg/day for both copper and cobalt) during the Fall 2000 round of sampling. There was a decrease in dissolved copper concentration and a reduction in load of 29% between stations BBSW-04 and BBSW-03. Cobalt concentrations increased from 0.166 mg/L to 0.298 mg/L in this reach and load increased from 0.4 kg/day to 0.66 kg/day (67%) during the Fall 2000 sampling. Seeps were not sampled in 2001.

- *West Fork Tailings Impoundment.* Loading from the West Fork Tailings Impoundment vary seasonally and from year to year. During low flow conditions (when concentrations are highest in Panther Creek), the West Fork Tailings Impoundment contributes about 70% (3 kg/day) of the cobalt loading from Blackbird Creek to Panther Creek as measured at BBSW-01A. Approximately 50% (7 kg/day) of the cobalt loading was due to the West Fork Tailings Impoundment during the Spring 2000 synoptic sampling event. The West Fork Tailings Impoundment contributes only small loading of copper, which is more than offset by the influence of the iron discharges from the impoundment. Copper sorbs to the iron hydroxides which causes a reduction in dissolved copper concentrations downstream of the impoundment.

- *Overbank Deposits along Blackbird Creek.* With the possible exception of contributions from seeps discussed previously, tailings and overbank deposits between Station BBSW-07 and the West Fork Tailings Impoundment do not appear to contribute dissolved copper load to Blackbird Creek, but may contribute a small cobalt load. There was a small increase of dissolved cobalt loading between Stations BBSW-07 and BBSW-06 (0.59 kg/day) during the Spring 2000 synoptic sampling event. During the Fall 2000 sampling event, small increases in cobalt loading were observed at each station from BBSW-07 to BBSW-03A, with a cumulative load increase of about 0.4 kg/day. From the West Fork Tailings Impoundment to the mouth of Blackbird Creek (Stations BBSW-02 to BBSW-01A), there was a net loss of dissolved copper load during both spring and fall sampling. Cobalt loading also declined between these stations during the Spring 2000 sampling, but cobalt loading increased by 0.85 kg/day between these stations during the Fall 2000 sampling. Stability of the overbank deposits and in-stream sediments and their potential for erosion was evaluated as part of the RI. The evaluation concluded that some areas of overbank deposits and in-stream sediments in Blackbird Creek upstream of the West Fork Tailings Impoundment have the potential for erosion. Some of the mine-related materials that were dredged by the USFS and piled on the bank can be accessed during peak flows. In some locations, surface water accumulates on the upslope of materials causing surficial erosion where it overtops the material. A 500-year design storm would likely result in mobilization of materials that contain elevated concentrations of metals. These materials would have the potential to be deposited in downstream areas at concentrations greater than the PRGs established for those areas.

The remaining sources of metals loading to Bucktail Creek, South Fork Big Deer Creek, and Big Deer Creek and Panther Creek downstream of Big Deer Creek include:

- *Bucktail Creek Seeps.* Groundwater discharge to Bucktail Creek between the 7000 dam and BTSW-01.6 is the primary source of remaining copper loading to Bucktail Creek. Synoptic sampling indicated that the overbank materials and in-stream sediments downstream from BTSW-01.6 do not appear to contribute significant metals loading under current conditions. However, if the groundwater sources upstream from BTSW-01.6 were to be remediated, there is a possibility that the debris flow materials and/or in-stream sediments downstream from BTSW-01.6 could begin to release metals through dissolution/desorption processes and therefore become sources.

- *Sediments and overbank material in South Fork Big Deer Creek.* During both the spring and fall synoptic sampling events there was an observed increase in dissolved copper concentrations between station SFSW-02 (downstream of Bucktail Creek) and SFSW-01 (upstream of confluence with Big Deer Creek). Sulfate concentrations also increased between these stations; however, there was no observed increase in cobalt. During the Spring 2000 synoptic sampling event, dissolved copper concentrations increased from 0.088 to 0.129 mg/L. During the fall event, the concentrations increased from 0.058 to 0.104 mg/L. These increases are likely due to either dissolution/desorption of precipitates from sediments or discharges from groundwater. Geochemical modeling indicates that dissolution of copper carbonates is likely occurring along this reach. While groundwater discharge is another possible source of these metals, there was no observed increase in flow between SFSW-02 and SFSW-01. However, accurate flow measurements are difficult to obtain in South Fork Big Deer Creek.

  During the spring 2002 synoptic sampling event there was an apparent increase in copper loading to Big Deer Creek between South Fork of Big Deer Creek and Panther Creek. This apparent copper loading was not observed during the fall of 2002 synoptic sampling event. Detailed synoptic sampling will be conducted during the spring 2003 synoptic event to further define the nature and extent of this apparent copper loading.

5.4.8 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates were sampled in area streams prior to the Early Actions in 1993, and subsequent to the Early Actions in 1998 through 2001. Benthic populations are continuing to show signs of recovery from impacts caused by metals, especially within Panther Creek. Recovery within Big Deer Creek is less pronounced. Blackbird and South Fork Big Deer Creeks exhibit much less recovery, although the total number of invertebrates within Blackbird Creek has increased since the Early Actions and a number of taxa were present in South Fork Big Deer Creek during 2000 and 2001, which previously had been devoid of invertebrates. Evidence for recovery is provided in a number of metrics evaluated, including the presence of metals sensitive species in areas downstream of mine discharges. During 2000, some individual metrics were higher at downstream stations in Panther Creek than they were at the upstream reference station. Recovery was observed at all stations between 1998 and 2001 and in comparison to 1993 pre-Early Action data. However, the downstream stations generally continue to have lower numbers of insects and lower densities than the reference stations.

Although there were increases in numbers of some species during 2000 (i.e., Hydroptila sp.), there were reductions in overall populations in most Panther Creek stations including the reference station in 2000 as compared to 1999. Ephemeroptera populations especially declined by large numbers during 2000. Increases in overall populations between 2000 and 2001 were observed at all Panther Creek stations except one. Additionally, Ephemeroptera populations improved at all Panther Creek stations except one. Although there were dramatic increases in numbers of some species between 1999 and 2000 (i.e., Hydroptila sp.), similar increases were seen only at the five uppermost Panther Creek stations between 2000 and 2001. Fewer Hydroptila sp. were seen at the other downstream stations in 2001 when compared to 2000 results. Year-to-year community composition variation may be attributed to a number of factors including: antecedent environmental and hydrological conditions (i.e., algal blooms, drought, flooding, water temperature, etc.); fluctuations in the life cycles of various invertebrate populations; and the effects of a large fire known as the Clear Creek Fire that occured in the area in 2000.

There is concern that ongoing recovery of invertebrates over the next several years may be affected by impacts from the Clear Creek Fire on hydrology and water quality. Numerous studies on the effects of fire on benthic macroinvertebrate populations have been conducted. The 2000 sampling round may only have been affected by very short-term effects related to the Clear Creek Fire and it is likely that additional impacts will occur over the next several years.

SECTION 6

CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section discusses the current and reasonably anticipated future land uses and current and potential beneficial groundwater uses at the Blackbird Mine site, and discusses the basis for future use assumptions. This information forms the basis for reasonable exposure assessment assumptions and risk characterization conclusions in Section 7.

6.1 LAND USES

6.1.1 Current Land Use

The Blackbird Mine is currently inactive. Workers at the mine are associated with operating the water treatment plant and performing long-term operations and maintenance of the facilities. Access to the mine is restricted by a gate; however, the mine area can be accessed on foot or by horseback. The Blackbird Mine is surrounded by National Forest land. The former Cobalt townsite is located on Panther Creek road approximately 8 miles from the mine and has no permanent residences. The closest inhabited town is Salmon which is located approximately 25 miles from the mine. The Lemhi County seat is located in Salmon. The closest permanent residence, the Panther Creek Inn is located 2 miles from the mine gate at the confluence of Blackbird Creek and Panther Creek (see Figure 1-1). The Panther Creek drainage basin downstream of the mine is rural and sparsely populated with seasonal and year round residences. The area surrounding the mine is used for recreational purposes including hunting, fishing and camping.

6.1.2 Future Land Use

The expected future use of the Blackbird Mine is to either remain abandoned or re-open mining activities. In January 2001 Formation Capital Corporation U.S. submitted a Plan of Operations to the Salmon-Challis National Forest for the proposed Idaho Cobalt Project which is located within a portion of the Blackbird Mine site. The Forest Service is currently preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) for the Idaho Cobalt mine proposal. Future receptors at the mine are expected to be mine workers, USFS personnel, recreational users, and trespassers. The expected future use of the surrounding area is recreational with seasonal and year-round residential use downstream of the mine in the Panther Creek drainage basin.

6.2 GROUND AND SURFACE WATER USES

The groundwater at the mine is not currently used. The groundwater underlying the mine and associated waste management areas is remotely located and is not expected to be used for domestic water supply. There is no water supply at the former town of Cobalt. The closest residence, the Panther Creek Inn, uses private water supply wells. Other residences in the area obtain water from private water supply wells or springs. It is expected that the wells along the Panther Creek drainage will continue to be used for private water supply.

Surface water downstream of the mine is currently used for irrigation and recreational purposes such as fishing, tubing, kayaking and camping. After surface water quality is restored by the remedial action in this ROD, the Natural Resource Trustees plan to reintroduce salmon in Panther Creek as part of a Natural Resource Damage settlement with the BMSG. In the future, it is expected that fishing in Panther Creek and other creeks will substantially increase.

SECTION 7

SUMMARY OF SITE RISKS

Human health and ecological risk assessments (aquatic and terrestrial) were conducted to evaluate the potential for current and future impacts of contaminants on receptors inhabiting, working or visiting in areas impacted by the Blackbird Mine. The baseline risk assessments estimate what risks the Blackbird Mine site poses if no further action was taken. They provide the basis for taking action and identifying the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessments for the Blackbird Mine site.

7.1 HUMAN HEALTH RISK ASSESSMENT

The Site-Wide Human Health Risk Assessment (HHRA) addressed areas that were not evaluated in the previous HHRAs performed for the Early Actions and included addenda to the previous HHRAs based on site characterization data and post-removal sampling data collected after the Early Actions were conducted. The summary provided in the following sections is for the Site-Wide HHRA, including the addenda to the Panther Creek Inn and Panther Creek Overbank Deposits HHRAs.

7.1.1 Identification of Chemicals of Concern (COC)

Chemicals evaluated in the human health risk assessment include those chemicals that exceeded background levels representative of the areas around the Site that are undisturbed by mining activities, and EPA risk-based screening concentrations (Region 9 PRGs). Based on these comparisons to background levels and screening levels, five COCs were identified for the Site (arsenic, cobalt, copper, iron, and manganese). Based on the findings of the human health risk assessment, arsenic was determined to be the primary COC.

7.1.2 Conceptual Exposure Model

A conceptual exposure model was developed that describes the potential exposure pathways associated with the soil, mine wastes, sediment, and surface water at the mine and along the creeks (see Figure 5-1). The receptors chosen for evaluation are based on knowledge of current and projected future use scenarios for the Blackbird Mine Site. The media chosen for consideration are those potentially impacted by historical mining activities for which there is a potential for human exposure.

7.1.3 Exposure Assessment

The objectives of the exposure assessment are to identify potential exposure scenarios by which humans could contact contaminants of concern in Site media and to quantify that potential exposure. The conceptual exposure model described in Section 7.1.2 shows that workers and persons who engage in recreational activities (i.e., day-users and campers) could potentially be exposed to contamination through the following exposure routes:

- Incidental ingestion of surface soil or mine wastes
- Dermal contact with surface soil or mine wastes
- Inhalation of re-suspended dust from the surface soil or mine wastes
- Incidental ingestion of sediment and dermal contact with sediment
- Incidental ingestion of surface water and dermal contact with surface water

The areas of the Blackbird Mine Site that were sampled from 1995 to 2000 were grouped into the following seven exposure areas based on receptor activity and the site conditions (i.e., proximity to the mine, stream reach, restricted access by the mine gates or fences):

- **Blackbird Mine Exposure Area**: The area at the Blackbird Mine

- **Upper Blackbird Creek Exposure Area**: The area along Blackbird Creek from the water treatment plant at the mine downstream to the Ludwig Gulch gate

- **Lower Blackbird Creek Exposure Area**: The area along Blackbird Creek from the Ludwig Gulch gate downstream to the Panther Creek Inn

- **West Fork Blackbird Creek Exposure Area**: The area surrounding the West Fork Blackbird Creek confluence with Blackbird Creek, including the West Fork Tailings Dam

- **Bucktail Creek Exposure Area**: The area along Bucktail Creek just below the upper sediment dam downstream to the confluence with South Fork Big Deer Creek

- **South Fork Big Deer Creek and Big Deer Creek Exposure Area**: The area along the South Fork Big Deer Creek and Big Deer Creek downstream to the confluence with Panther Creek (including the Slavins Pond area)

- **Panther Creek Exposure Area**: The area from the confluence with Blackbird Creek along Panther Creek, including the Panther Creek Inn

The seven exposure areas are considered in the HHRA because they are areas that have been potentially impacted by past mining activities at the Blackbird Mine; where waste rock, overburden, and sediment were deposited; and areas that were impacted by runoff or flooding. The impacted environmental media include soil, instream sediments, groundwater, and surface water. For the mine and along the creeks, it was assumed that current and future scenarios (i.e., operation and maintenance of the water treatment system, camping, and day-use of the areas) are the same and that the mine will not reopen.

The current Forest Plan indicates that the Forest Service property along the Panther Creek area will remain as a recreational resource in the future. It is assumed that exposure of people involved in recreational activities is predominantly to surface soil, sediments, and surface water. Because construction activities that would bring subsurface soil to the surface are not anticipated for Forest Service property, the risks associated with such a scenario were not calculated.

Some private property along Panther Creek is used for residential purposes. It was assumed that the present residential use would continue and that some additional future residential use could be anticipated.

Although existing land use will likely remain the same as the current use into the foreseeable future, significant changes may occur. If land use changes significantly at the mine or along the creeks in the exposure areas, the exposure scenario assumptions may need to be reviewed. To calculate risk estimates for the COCs, the magnitude of exposure was first estimated. The exposure assumptions for the exposure scenarios are summarized in Tables 7-1, 7-2, and 7-3.

7.1.4 Exposure Point Concentrations

Exposure point concentrations were calculated for each exposure area. The exposure point concentration should represent the "average" concentration of each COC that a person may contact over the period of exposure. According to EPA guidance, the exposure point concentrations are the 95 percent upper confidence limit (95 UCL) on the mean concentration, assuming either a normal or a log-normal distribution. The exposure point concentrations for COCs in the exposure areas are presented in Tables 7-4 through 7-6.

7.1.5 Toxicity Assessment

The toxicity assessment seeks to develop a reasonable appraisal of the associations between the degree of exposure to a chemical and the possibility of adverse health effects. The toxicity assessment consists of two components: 1) hazard identification and 2) dose-response evaluation. Hazard identification is the process of determining what adverse human health effects, if any, could result from exposure to a particular chemical. Dose-response evaluation is a quantitative examination of the relationship between the level of exposure and the probability of adverse health effects in an exposed population.

Health effects are divided into two categories: non-cancer and cancer effects. The division is based on the different mechanisms of action associated with each category. Risks of developing cancer due to a site exposure are evaluated based on toxicity factors (slope factors) published by EPA. Quantification of non-cancer effects relies on published reference doses (RfDs). The slope factors (SFs) and RfDs are derived from either Integrated Risk Information System (IRIS), Health Effects Assessment Summary Table (HEAST), or the National Center for Environmental Assessment (NCEA). Chemicals with non-cancer effects may have cancer effects as well. Arsenic is the only COC for the Site that exhibits both cancer and non-cancer effects; cobalt, copper, and iron exhibit only non-cancer effects. The estimation of risk resulting from ingestion of arsenic-contaminated surface soil/mine wastes or sediment included an adjustment based on the estimated bioavailability (i.e., percentage of arsenic in soil that is available for human uptake). Based on studies performed to quantify the percentage of arsenic uptake, EPA Region 10 has utilized a 60 percent relative bioavailability of arsenic if the source of arsenic is mining activities such as those that occurred at the Blackbird Mine.

7.1.6 Risk Characterization

The EPA toxicity values described above were used in this risk assessment along with the exposure information to estimate the potential risks from contacting COCs in surface soil/mine wastes, sediment, and surface water. Risk estimates were calculated for current and likely exposure scenarios under current environmental conditions.

The potential for carcinogenic effects is evaluated by estimating excess lifetime cancer risk. Excess lifetime cancer risk is the incremental increase in the probability of developing cancer during one's lifetime over the background probability of developing cancer if no exposure to site-related contaminants occurred. For example, a 1×10^{-6} excess lifetime cancer risk means that for every 1 million people exposed to the chemical at the defined exposure conditions averaged over a lifetime, the average incidence of cancer is increased by one case of cancer. EPA uses the general range of 1×10^{-6} to 1×10^{-4} as a "target range" for total excess lifetime cancer risks within which the agency strives to manage risks.

Non-cancer risk is assessed by comparing the estimated daily intake of a contaminant to its reference dose (RfD). The resulting ratios are termed Hazard Quotients (HQ). The HQs from the various exposure routes (i.e., incidental ingestion, dermal contact, and inhalation) are then summed to give a Hazard Index (HI). When the HI exceeds 1 (i.e., the intake of the chemical is greater than the RfD), there is potential for health concern.

7.1.6.1 Site-Wide HHRA

Potential exposures to surface soil/mine wastes, sediment, and surface water were evaluated in the Site-Wide HHRA. Table 7-7 summarizes the cancer and non-cancer risks assuming reasonable maximum exposure (RME) and central tendency exposure (CTE) conditions for surface soil/mine wastes. There are no RME scenarios with estimated cancer risks greater than 1×10^{-4}. Most of the RME scenarios result in estimated cancer risks greater than 1×10^{-6}, with approximately one-third of the scenarios greater than 1×10^{-5}. The highest estimated cancer risk, 3×10^{-5}, is for the age-adjusted day-user at the Upper Blackbird Creek and West Fork Blackbird Creek exposure areas and the adult worker at the Blackbird Mine exposure area. There are no RME scenarios that have an RME non-cancer HI equal to or greater than 1.

The risks for exposure to sediment and surface water are within or below the NCP acceptable risk range. The highest estimated cancer risk for sediment, 1×10^{-5}, and highest HI, 0.09, were estimated for the age-adjusted day-user for the Lower Blackbird Creek exposure area, and the child day-user for the West Fork Blackbird Creek exposure area, respectively. The highest estimated cancer risk for surface water, 1×10^{-5}, and highest HI, 0.07, were estimated for the adult worker and adult day-user for the Blackbird Mine exposure area. Tables 7-8 and 7-9 summarize the non-cancer risks assuming RME and CTE conditions for sediment and surface water, respectively.

The results of this risk assessment indicate that the risks of exposure to contaminated surface soil/mine wastes, surface water, and sediment do not exceed the acceptable risk range for carcinogenic effects (i.e., 1×10^{-4} to 1×10^{-6}) or for noncarcinogenic effects (i.e., HI > 1). Table 7-10 shows the estimated cumulative risk (i.e., summing the risks of exposure to each medium) by receptor. None of the estimated cumulative cancer risks are greater than 1×10^{-4}. The adult worker at the Blackbird Mine exposure area has the highest estimated cumulative cancer risk, 4×10^{-5}. None of the estimated non-cancer HIs are greater than 1.

Arsenic is the predominant risk driver (parameters that represent the majority of the risk are referred to as risk drivers), contributing 100 percent of the cancer risk estimates, as the only carcinogenic COC identified, and generally between 80 and 100 percent of the non-cancer HI. Although the risks from exposure to contaminated media in the exposure areas do not exceed the acceptable risk range, there are locations within the Blackbird Creek exposure areas that may present unacceptable acute or chronic risks if the exposure is limited to a small area.

7.1.6.2 Addendum to the Panther Creek Inn HHRA

There is an area along Blackbird Creek adjacent to the Panther Creek Inn that was not cleaned up as part of the Early Actions. This area is between the Panther Creek Road bridge and the Blackbird/Panther Creek confluence and between the existing berms that parallel Blackbird Creek. This area includes overbank materials and in-stream sediments with elevated arsenic concentrations. Potential risks associated with exposure to these in-stream sediments were estimated using a site-specific residential scenario (i.e., exposure frequency and exposure time for exposure to sediments in the creek were adjusted for seasonal conditions). The risk estimate for the in-stream sediments exceed EPA's acceptable risk level for noncarcinogenic effects with a Hazard Index of 3.

In addition, several surface soil samples collected along the banks of Blackbird Creek channel (i.e., overbank deposits) in the vicinity of the Panther Creek Inn, inside the berm, have elevated arsenic. Potential risks associated with exposure to the soils between the berms were shown to be 7×10^{-4} to 2×10^{-3} for cancer risks and Hazard Indices ranging from 3 to 30 for noncarcinogenic effects under a residential use scenario.

7.1.6.3 Addendum to the Panther Creek Overbank Deposits HHRA

In the Panther Creek Overbank Deposit HHRA addendum, a discussion of the Early Actions performed along Panther Creek, the additional site characterization work, and an update to the risk calculations for potential exposure to the Panther Creek Overbank Deposits were presented. Early actions that involved removal of material with concentrations greater than the established cleanup levels were completed between 1999 and 2001 at the sites along Panther Creek that posed a potential risk under current use conditions. Areas that posed a potential risk under a future use scenario were deferred to the final remedial action. Based on the additional site characterization samples, risks for three private properties ([redacted], former [redacted], and [redacted]) still exceed EPA's acceptable risk range for the future residential scenario. Areas on the [redacted] property showed cancer risks from 2×10^{-4} to 4×10^{-4} and Hazard Indices ranged from 2 to 7 for noncarcinogenic effects. The [redacted] property showed a cancer risk of 3×10^{-4} and a Hazard Index of 3 for noncarcinogenic and the [redacted] property showed a cancer risk of 3×10^{-4} and Hazard Indices from 2 to 6 for noncarcinogenic.

Although the risk estimates for current exposure scenarios exceed EPA's acceptable range for the [redacted] property, additional samples were not collected. During the completion of the 1999 HHRA, it was recommended that more sampling be conducted to adequately characterize this exposure area. However, the property owner has denied access for further sampling. Consequently, there are uncertainties associated with use of the limited data set (comprised of two discrete samples) for estimating risk and for evaluating the need for remedial action at the [redacted] property.

Between 1995 and 1998, nine soil samples were collected from, or near, the Panther Creek Road, between Blackbird Creek and Napias. None of the metals analyzed in these samples collected along the road exceed the USEPA Region 9 PRG for a residential exposure scenario, with the exception of arsenic. However, none of the collected arsenic samples exceed the background concentration level for arsenic.

7.1.6.4 Groundwater at the Blackbird Mine

Potential risks associated with drinking water from a future groundwater source at the mine site (i.e., a well) were evaluated. This evaluation assumed that workers at the mine site were the receptors of concern, and that these workers would be at the site for 167 days per year for 25 years and that they would consume 2 liters of water per day from a groundwater source. The potential risks were evaluated based on existing data from groups of monitoring wells from four different areas at the site. The data used to perform the risk evaluation are summarized in Table 5-1a. The potential risks were estimated by using the maximum detected concentrations of arsenic, cobalt and copper in each group of monitoring wells. The potential risks and Hazard Quotients are as follows:

Blackbird Creek Drainage Wells
Arsenic Potential risk = 5×10^{-4}
Cobalt HQ = 2
Copper HQ = 0.4

Bucktail Creek Drainage Wells
Arsenic Potential risk = 1×10^{-4}
Cobalt HQ = 8
Copper HQ = 10

West Lobe Bucktail Creek Drainage Wells
Arsenic not detected
Cobalt HQ = 0.1
Copper HQ = 0.02

West Fork Impoundment Wells
Arsenic Potential risk = 7×10^{-4}
Cobalt HQ = 10
Copper HQ = 0.3

In addition, groundwater at the Blackbird Mine exceeds the Maximum Contaminant Level (MCL) of 10 ug/L for arsenic in Blackbird Creek drainage and at the West Fork Tailings Impoundment.

7.1.6.5 Summary of Risks

Based on the results of the Site-Wide Human Health Risk Assessment (including addenda to the two previous risk assessments for the Panther Creek Overbank Deposit Areas and the Panther Creek Inn), the potential risks for the following areas of the Blackbird Mine Site exceed EPA's acceptable risk range:

- Small localized areas of soil along the banks of Blackbird Creek (i.e., overbank soil/deposits) with elevated arsenic concentrations that may present unacceptable acute (short-term) or chronic (long-term) risks during recreational use.

- In-stream sediments and overbank deposits along the bank of Blackbird Creek adjacent to the Panther Creek Inn downstream from where Panther Creek Road crosses Blackbird Creek show a potential risk to residents who live at the Inn.

- Three private properties along Panther Creek ([redacted], former [redacted], and [redacted]) have potential risks that exceed EPA's acceptable range for hypothetical future residential use.

- Groundwater in the Blackbird Creek and Bucktail Creek drainages and at the West Fork Tailings Impoundment exceed EPA's acceptable risk range and exceeds the MCL for arsenic in the Blackbird Creek drainage and at the West Fork Tailings Impoundment.

7.1.7 Tailing Deposits and Remobilization of In-stream Sediments Along Blackbird Creek

Tailing deposits and in-stream sediments along Blackbird Creek also are of concern due to potential remobilization and recontamination of Blackbird Creek and Panther Creek during major storm events.

7.1.8 Uncertainties

A number of uncertainties are associated with each step of the risk assessment process. The key uncertainties are briefly described below.

In the data evaluation and exposure assessment steps, available sampling data may not completely characterize an "exposure area." An exposure area is that portion of the property that is contacted on a daily basis by workers or recreational users. It is possible that some people may limit their activities on a daily basis in exposure areas designated in the risk assessment (e.g., children who regularly play in a small area directly adjacent to the creek). However, the actual daily exposure of people may extend over a larger area than the exposure areas considered in the risk assessment. The actual exposure areas may include areas that have not been affected by activities at the mine. Because samples were generally collected in areas where the impact from the mine is most probable (e.g., in areas of visible tailings), for some receptors it is likely that the exposure point concentrations for the exposure areas are overestimated. Consequently, the risk estimates for the exposure areas and exposure scenarios considered in this risk assessment are conservative.

The exposure scenarios addressed in this risk assessment are based on an assumption that the existing mine is not open and that a proposed cobalt mine is not opened in the same ore body. If a mine is opened in the same ore body, the assumptions used to estimate exposure would likely change. For example, exposure frequency and duration would likely increase for workers.

The exposure scenarios are based on the assumptions that exposure occurs over a large area. Unacceptable acute and chronic risks may potentially exist from exposure to hotspots or other areas smaller than the exposure areas with elevated concentrations. Under certain exposure conditions, the estimated risks to receptors to these smaller areas may exceed the acceptable risk range.

The exposure assumptions that were used in the risk assessment (e.g., exposure frequency and duration) were based on assumptions of how receptors used the areas. These assumptions are supported by limited interviews with persons who use the areas that were sampled, local residents, and USFS personnel who have general knowledge about recreational use of the area.

Uncertainties are also associated with the toxicity values that were used to calculate the risk estimates. This uncertainty is due, in part, to the deficiencies identified in the various studies performed on populations exposed to arsenic, either as a result of workplace exposure or environmental exposure. There is also uncertainty associated with the provisional oral RfD for iron. However, in general, the methods used to derive slope factors and RfDs are intended to be conservative in recognition of the uncertainties associated with most epidemiologic or toxicologic data sets.

The estimation of risk resulting from ingestion of arsenic-contaminated surface soil/mine wastes and sediment included an adjustment based on the estimated bioavailability (i.e., percentage of arsenic in soil that is available for human uptake). Based on studies performed to quantify the percentage of arsenic uptake, EPA Region 10 recommends assuming a 60 percent relative bioavailability of arsenic if the source of arsenic is mining activities such as those that occurred at the Blackbird Mine.

7.2 AQUATIC ECOLOGICAL RISK ASSESSMENT

This section summarizes the results of the aquatic ecological risk assessment for the Blackbird Mine site. The objectives of the assessment were to evaluate the potential adverse effects to ecological receptors from contaminants being released from the site under current conditions after implementation of Early Actions. The risk assessment focused on identifying and evaluating risks to the aquatic ecosystems of Blackbird Creek, Panther Creek, Bucktail Creek, South Fork of Big Deer Creek, and Big Deer Creek.

The risk assessment followed the protocol developed by the EPA for performing ecological risk assessments (EPA, 1992; 1998) and was consistent with the requirements for ecological risk assessment at Superfund sites (EPA, 1997). The risk assessment consists of four steps:

- Problem Formulation includes the site description, identification of chemicals of potential ecological concern (COPEC), assessment and measurement endpoints, conceptual site model, and a summary of the data used in the risk assessment.

- Exposure Assessment which describes the exposure to benthic invertebrates and fish.

- Effects Assessment which identifies the physiological and toxicological interactions of the COPECs with the aquatic ecosystem and its inhabitants.

- The last step is the Risk Characterization whereby the results of the Effects Assessment are linked with the Exposure Assessment to provide an estimate of risks to the aquatic environment.

7.2.1 Ecological Setting

The fisheries and aquatic resources downstream of the influence of the Blackbird Mine have undergone significant alteration since large-scale operation of the mine began in the 1940s. Prior to the implementation of Early Actions, dissolved copper concentrations in Panther Creek and Big Deer Creek frequently exceeded the Idaho water quality standard for the protection of aquatic life by a factor of 10 or more. Historically, the Panther Creek drainage is reported to have supported runs of anadromous chinook salmon and steelhead trout. Water quality impacts from the mine contributed to the significant declines in chinook salmon and steelhead runs in Panther Creek. The Snake River spring/summer chinook salmon (Onchorynchus tshawytscha), known to have historically used this basin, has been designated as threatened under the Endangered Species Act. Snake River steelhead (Onchorynchus mykiss) and Columbia Basin bull trout (Salvelinus confluentus) are also listed as threatened.

Resident fish populations are not present in Blackbird, South Fork Big Deer, or Big Deer creeks downstream of the mine influence. Blackbird Creek is currently considered to be uninhabitable by most aquatic life in the zone of influence of the mine, but resident trout (species unknown) are present above the influence of the mine and in the freshwater reservoir. In Big Deer Creek, one salmonid species (resident rainbow trout) is known to occur upstream of the mine discharges, with other species potentially present. Above the mine inflow into South Fork Big Deer Creek, NOAA reported in 1994 that rainbow trout were present at population levels approximately equal in density to similar streams in the drainage basin. However, subsequent information has not indicated the presence of fish in this reach of the South Fork Big Deer Creek. Additional information is needed to determine if fish are present in this reach. Bucktail Creek likely never supported significant fish populations due to the high gradient and low flow.

The structure of the benthic macroinvertebrate community in Panther Creek and the tributary streams was also impacted by the mine. Benthic invertebrates are a main food supply for salmonids and are important indicators of stream impairment. Overall populations of benthic macroinvertebrates, with the exception of pollution tolerant chironomids, had been reduced in aquatic habitats downstream of the mine. Prior to implementing Early Actions, sensitive species of mayflies, caddis flies, and stoneflies, which are principal components of the diet of salmonids, were mostly absent within the zone of influence of water quality impacts from the mine. The Early Actions have resulted in improved water quality and the benthic macroinvertebrate community has shown signs of recovery, especially in Panther Creek. However, the benthic macroinvertebrate community is still impacted when compared to reference stations.

7.2.2 Identification of Chemicals of Concern

The Blackbird Mine Site investigations determined that there were six chemicals of potential ecological concern (COPEC): arsenic, cobalt, copper, manganese, nickel, and zinc. These metals were compared to the federal Ambient Water Quality Criteria (AWQC), the background surface water concentration, and the maximum surface water concentration. Based on this comparison, cobalt and copper were identified as COPECs for surface water for the aquatic risk assessment. Zinc, nickel, and manganese were below risk screening levels and, therefore, were not carried through into the risk assessment as COPECs. Iron concentrations at the site exceed the AWQC.

A comparison similar to that performed for surface water was also performed for sediments to identify COPECs. Applicable and relevant sediment screening criteria were reviewed for each metal to determine whether the metal should be considered a COPEC and evaluated further in the risk assessment. Based on the comparison of sediment data to screening criteria from the literature, arsenic, cobalt, copper, and iron were further evaluated as COPECs in sediments.

7.2.3 Conceptual Exposure Model

A conceptual exposure model was developed that describes the potential exposure pathways associated with the soil, mine wastes, sediment, and surface water at the mine and along the creeks (see Figure 5-2). The conceptual model describes the sources of contamination at this site. It describes the major transport pathways by which contamination moves from the point of origin to a point where ecological receptors become exposed. The conceptual model also identifies the major exposure media and the receptors of concern. There are two exposure media evaluated. These are surface water and sediment. Groundwater is also evaluated but as a transport pathway to surface water and sediments. Receptors are species of aquatic life that contact exposure media contaminated by site-related metal contamination.

7.2.4 Data Used in Risk Assessment

The maximum dissolved surface water concentrations at each sampling location were used in the risk assessment as the Exposure Point Concentrations (EPC) for the basis of the risk estimates; the exception was iron, where the maximum total surface water concentration was used since the ecological criteria for iron are based on total concentrations.

Sediment data were collected from various locations from streams in the Blackbird Mine vicinity during 2000. The maximum sediment concentrations on a dry-weight basis at each sampling location were used in the risk assessment as the EPCs as the basis of the risk estimates.

Benthic invertebrates were evaluated as a food source for salmonids. The dietary exposure pathway was evaluated by estimating the dietary exposure to salmonids from eating benthic invertebrates. Dietary exposure was estimated by predicting tissue concentrations in benthic invertebrate food items and comparing the modeled dietary concentration to concentrations from the literature where no effect and adverse effects levels were identified. The dietary exposure pathway was evaluated for salmonids only.

7.2.5 Effects Assessment

The Effects Assessment consisted of identifying the potential adverse effects that release of copper, cobalt, arsenic, or iron could have on aquatic receptors in the aquatic ecosystem. Toxicity information in the form of toxicity data reported in the literature for COPECs for surface water and sediments, site-specific testing (bioassays and other testing), and screening levels were reviewed for each metal. Toxicity reference values (TRV) formed the basis of the risk estimates and included the AWQC for surface water, EPA Region V (EPA, 1999) Ecological Screening Values (ESV), and National Oceanic and Atmospheric Administration (NOAA) Coastal Protection and Restoration Division (Buchman, 1999) benchmarks for sediments, as well as values derived from the peer-reviewed and site-specific literature. Effects on benthic macroinvertebrates, a primary food supply for salmonids, were also addressed directly by evaluating benthic invertebrate community data.

The TRVs are the values used in conjunction with data from the exposure assessment to perform risk characterization. The use of TRVs as the basis for calculating the Hazard Quotients (HQ), or ratio of the EPC to the appropriate TRV, is only one line of evidence that was evaluated in the aquatic risk assessment. The TRVs were chosen after review of literature, the relevant and appropriate site-specific toxicity studies, and existing screening levels (ecological criteria and guidance) for the COPECs and media of concern (i.e., surface water and sediment).

7.2.5.1 Surface Water TRVs

The surface water TRV values are derived from the Idaho Water Quality Standards (WQS) where available. Due to the considerable amount of information reviewed and integrated in developing the WQS, they were chosen as the most appropriate TRVs for analysis of risks to aquatic life. WQS were available for copper and iron.

For cobalt, a state or federal criterion does not currently exist, thus the cobalt TRVs were based on peer-reviewed or regulatory literature and site-specific testing. A cobalt TRV likely to be protective of all forms of aquatic life was obtained from Suter and Tsao (1996), and includes toxicity data for various species of invertebrates, amphibians, and fish. Data suggest that salmonids may be more tolerant of cobalt toxicity than invertebrates; thus, a TRV protective of salmonids only was developed for cobalt as well. Table 7-11 presents the TRVs for surface water.

Table 7-11
Surface Water TRVs

COPEC	TRV (mg/L)[1]	Source
Cobalt (aquatic life)	0.023	Chronic Tier II value (Suter and Tsao, 1996)
Cobalt (salmonids)	0.038	Weight-of-evidence for literature and site-specific testing
Copper	varies[2] 0 0035 at a hardness of 25 mg/L	IDAPA 58 0102 210
Iron	1	CFR, 1999

1 Dissolved cobalt or copper in surface water; total iron in surface water.
2 The TRV for copper is corrected for hardness when comparing to site-specific data.

7.2.5.2 Sediment TRVs

A review of the benthic macroinvertebrate data indicates that the health of the benthic invertebrate community is improving. Because of the naturally high mineralization of the area and the possibility of adaptation of the benthic community to elevated metal concentrations, it is possible that populations of benthic macroinvertebrates may survive at concentrations higher than indicated in the literature. Site-specific toxicity data were also considered when evaluating potential sediment TRVs; levels producing no effects in site-specific testing were below the TRVs, and adverse effect levels were above the selected sediment TRVs. This suggests that the TRVs are adequately protective, but not overly conservative.

The sediment TRV values are the threshold effects concentration (TEC) or levels producing no adverse effects from other sources. The sediment TRVs are summarized in Table 7-12.

Table 7-12 Sediment Toxicity Reference Value (TRV) Selection				
COPEC	**EPA Region V ESL (EPA, 1999) (mg/kg)**	**NOAA Squirt Table (Buchman, 1999) (mg/kg)**	**TEC (MacDonald *et al.*, 2000)[3] (mg/kg**	**Sediment TRV Selected (mg/kg)**
Arsenic	6	61	9.79	9.79
Cobalt	50	NA	NA	50
Copper	16	362	31.6	31.6
Iron	NA	40000	NA	40,000

1 Based on the Threshold Effects Level (TEL).
2 Upper Effects Threshold (UET), no TEL was reported for these metals
3 The TEC is the preferred value. In the absence of a TEC, the lowest available value was used.
NA - not available

7.2.6 Risk Characterization and Determination

The potential risks to ecological receptors were predicted with an HQ. The HQ is a ratio of the EPC to the TRV for water or sediment exposure, or the ratio of the modeled dietary concentration to the appropriate dietary TRV. An HQ in excess of 1 indicates a potential for risk, whereas an HQ below 1 indicates little potential for adverse effects.

Background concentrations which are discussed in Section 5 are used for comparative purposes in the following summary of aquatic ecological risks for each creek.

7.2.6.1 Blackbird Creek

All the lines of evidence indicate that metals in surface water and sediment in Blackbird Creek have potential for adversely affecting the aquatic ecosystem. Surface water HQs for the protection of aquatic life and salmonids were consistently greater than 10 for copper and cobalt during high flow. During low flow, they were generally greater than 10 for both copper and cobalt. The sediment HQs were greater than 50 to100 for arsenic, and concentrations were up to 38 times higher than background levels of arsenic. The sediment HQs for copper were nearly 50 to more than 100; copper concentrations in Blackbird Creek were 2 to 5 times higher than background. Cobalt HQs ranged from 7 to 10, and were greater than background by a factor of 2. The benthic community data also indicate that there is the potential for adverse effects to the aquatic system since the downstream station does not resemble the reference stations.

7.2.6.2 Panther Creek

Panther Creek has shown improvements in water quality with the implementation of the Early Actions. The lines of evidence reflect this improvement; however, there is still potential for adverse effects to the aquatic ecosystem. Chronic and acute surface water HQs for copper during high flow ranged from 2 to 6. During low flow, surface water HQs were less than 1 for copper, indicating low potential for adverse effects during this period. Surface water HQs for cobalt ranged from 1 to 3 during both high and low flow periods, based on protection of aquatic life. Based on protection of salmonids, cobalt HQs ranged from less than 1 to 2. Sediment HQs for all metals ranged between 1 and 21, and metal concentrations were <1 to 6 times higher than background. The highest metal concentrations above background in sediments were found at station PASW-08A. The benthic stations along Panther Creek are beginning to resemble the Panther Creek reference station but still show impacts due to metals.

The comparison to background, the surface water and sediment HQs, and the benthic community data suggest continuing effects on the aquatic ecosystem, although improvement has been observed due to implementation of the Early Actions.

7.2.6.3 Bucktail Creek

Bucktail Creek continues to have very poor water quality. HQs for surface water were the highest along this creek and exceeded 2000 for copper.

7.2.6.4 South Fork of Big Deer Creek

The lines of evidence for the South Fork of Big Deer Creek indicate there is potential for adverse affects due to mine wastes. Surface water HQs were lower in 2000 than 1999; this may reflect continued improvements as a result of implementation of Early Actions. Surface water HQs for copper range from 4 to 66 during high flow and up to 13 during low flow. Surface water cobalt HQs protective of aquatic life range from 2 to 9 during high flow and from 2 to 4 during low flow. Surface water cobalt HQs for the protection of salmonids were 2 in the year 2000. Sediment HQs ranged from less than 1 to 203. Arsenic concentrations were 5 times higher than background conditions, and copper concentrations were 10 times higher than background conditions. The benthic community along South Fork of Big Deer Creek continued to be impacted, with most of the indices evaluated at the downstream stations not resembling those at the reference station.

7.2.6.5 Big Deer Creek

The lines of evidence for Big Deer Creek indicate some improvements in water quality. Surface water HQs for copper improved between 1999 and 2000 and ranged from 2 to 4. The improvement in surface water HQs between 1999 and 2000 may reflect the implementation of Early Actions. Surface water HQs for cobalt were below 1 for all the sampling events, indicating low potential for adverse affects due to cobalt. Sediment HQs ranged from <1 at the reference location to 12 at BDSW-01 for copper; HQs for arsenic, iron, and cobalt were <1 at the reference location and downgradient areas. Cobalt sediment concentrations were two times higher than background, and copper sediment concentrations were four times higher than background. The benthic community is beginning to resemble the reference station for several indices; however, effects due to metals are still being observed.

7.2.6.6 Uncertainties

Surface Water

The surface water matrix is well mixed and more homogenous than the sediment matrix. Thus, there are fewer potential variables introduced on the basis of matrix composition alone.

The surface water TRVs for copper and iron are based on Idaho WQS, which in turn are based on a large database and, as such, are relatively certain. The cobalt criterion is based on a more limited data set, and as such is more uncertain, but is corroborated by site-specific toxicity testing. The surface water TRVs may underestimate or overestimate toxicity at the Blackbird Mine Site.

Sediment

Many factors contribute to the uncertainty in assessing the ecological risk due to exposure to contaminated sediments. There is a limited data set for sediment, which increases the uncertainty. The sediment matrix is highly variable physically, which allows metals concentrating in fines to accumulate in low-flow (i.e., pool) areas to a greater extent than in high-flow (i.e., ripple) areas. Total organic carbon (TOC) can decrease toxicity, and TOC tends to accumulate in low-flow as opposed to high-flow areas as do the fines. Thus, toxicity can be the same in areas with fines and high TOC as in areas with larger-grain sizes and low TOC. This increases the uncertainty in the sediment TRVs, since toxicity is influenced by sediment factors. This also increases uncertainty in the exposure estimates, since physical variables also can influence exposure.

The sediment matrix is also variable chemically, and various inorganics such as calcium, magnesium, and other elements are distributed heterogeneously. Metals adsorbed to sediment particulates also are distributed heterogeneously; thus, sediments from different locations can exhibit widely different chemical characteristics although located spatially close to one another. This increases the uncertainty in evaluating exposure by aquatic receptors in contact with sediments, since concentrations vary spatially. The chemical characteristics of sediments increase uncertainty, since they can affect toxicity and bias the risk assessment results either high or low.

The sediment TRVs contain uncertainty because they are developed from data from other stream systems, with different benthic communities and with different sediment characteristics.

However, the sediment TRVs represent the most current and comprehensive evaluation available for addressing sediment toxicity. The sediment TRVs may overestimate or underestimate toxicity at the Blackbird Mine Site. There are also uncertainties associated with the statistical tests that were performed to determine the UTL of the background sediment data set. A data set representing pre-mining conditions does not exist. The PRGs based on sediment background may overestimate or underestimate the background UTLs. The UTLs for Panther Creek and Big Deer Creek do not account for the contribution of the mineralized ore body and therefore, may underestimate the background UTL.

The availability of limited site-specific data helps reduce uncertainty in the risk assessment estimates and the TRVs used to make those estimates. The benthic community data evaluated in the Aquatic Ecological Risk Assessment (AERA) indicated that all streams downgradient of metal impacts had corresponding impacts on the benthic community. Panther Creek, with generally the lowest sediment HQs, also exhibited the most minimal benthic community impacts. Thus, the data corroborate the risk analysis. In addition, site-specific toxicity test results indicated that the sediment toxicity-based TRVs were appropriate for the Blackbird Mine Site, since TRVs were lower than measured adverse effect levels in Panther Creek.

7.3 TERRESTRIAL ECOLOGICAL RISK ASSESSMENT

A terrestrial ecological risk assessment (TERA) was conducted as part of the RI/FS of the Blackbird Mine Site. The purpose of this risk assessment was to determine the risk to populations of receptors of concern (ROC) from mine-related deposits within the riparian zones of Blackbird Creek, Panther Creek, Bucktail Creek, South Fork Big Deer Creek, and Big Deer Creek. Several wildlife and plant communities are present in the greater Blackbird Mine area, which is comprised of several drainages: Panther Creek, Bucktail Creek, South Fork Big Deer, and Big Deer Creeks. The primary habitat type within the impacted areas of these drainages is riparian. Potential risks to ROC populations due to exposures within waste rock piles and tailing impoundment areas were also evaluated. Reference areas included the riparian zones upstream of Panther Creek, West Fork Blackbird Creek upstream of the mine and tailings impoundment, and Big Deer Creek upstream of South Fork Big Deer Creek

COPECs were identified using a screening process that included metals that occurred at higher concentrations than reference areas. Arsenic, copper, and cobalt were determined to be COPECs for terrestrial resources in the greater Blackbird Mine area. Two management goals were identified and focused on the protection of populations of ROC rather than individuals: 1) habitat suitability and community structure adequate to support healthy populations of ROC within the study area; and 2) food resource quality adequate to support healthy populations of ROC within the study area. The risk characterization was based on the overall weight of evidence produced by several measured and modeled responses. The lines of evidence included measured responses of the plant community and small mammals along the COPEC concentration gradient, the modeled effects of mine-related deposits on habitat suitability for each ROC, the relative spatial extent of changes in habitat suitability, measured tissue concentrations, site-specific bioaccumulation factors, impact on home ranges (HR), the abundance of food resources, and Tier 1, Tier 2, and Tier 3 HQ values. Tier 1 HQs were based on exposure estimates using maximum soil concentration and a no observed adverse effect level (NOAEL). Tier 2 HQs based exposure on a 95 percent UCL of the mean soil concentration and the lowest observed adverse effect level (LOAEL). In Tier 3, HQs were based on a mean soil concentration and an LOAEL. The evaluation of lines of evidence was hierarchical, in ascending order of spatial resolution (i.e., individual-level risks using point estimates of exposure, risks at the subpopulation level, and risks at the population- evel). Weight of evidence was then related to the ecological management goals.

A summary of the terrestrial risk for each creek follows.

7.3.1 Blackbird Creek

Risks along Blackbird Creek were identified for individuals and sub-populations of deer mice, shrews, and ground squirrels living in the riparian zone. Individual robins were also identified as being at risk based on high Tier 2 and Tier 3 HQs and changes in habitat suitability. Tier 3 HQs for arsenic for the shrew and the robin were 2 and 5, respectively. Tier 3 HQs for cobalt ranged from 13 to 35 for all four receptors. Although sub-population risks to these receptors were identified in riparian habitat along Blackbird Creek, population-level risks for all ROC in the Blackbird Creek drainage were considered negligible.

7.3.2 Panther Creek

The weight of evidence from all measured and modeled data for Panther Creek indicated that population and sub-population risks were generally negligible. Individual risks exist, however, for deer mice, shrews, ground squirrels, and robins because Tier 2 (95 percent UCL exposure exceeded the LOAEL) or Tier 3 (mean exposure exceeded the LOAEL) HQs were greater than 1 for deer mice, shrews, and robins in particular areas and because of changes in habitat suitability in a number of home ranges for these ROCs.

7.3.3 Bucktail and South Fork of Big Deer Creek

COPECs in media from Bucktail and South Fork of Big Deer Creeks were found to pose potential risks to individual deer mice, shrews, robins, and ground squirrels due to both changes in habitat suitability and food resource quality. Risks to sub-populations and populations of deer mice, shrews, ground squirrels, and robins along Bucktail and South Fork Big Deer Creeks were considered negligible because of the very small number of home ranges affected (unlikely to represent a sub-population) and because of the minimal changes in habitat quality.

7.3.4 Big Deer Creek

Risks to individual deer mice, shrews, and robins exist along Big Deer Creek because of changes in food resource quality. Risks to populations and sub-populations of deer mice, robins, and shrews along Big Deer Creek were considered negligible because Tier 3 HQs were approximately 1, and because there were no significant changes in habitat quality.

7.3.5 Waste Rock Piles and Tailings Impoundment Area

The qualitative analysis of information on the waste rock piles and tailings impoundment area indicated that although the waste rock piles may provide suitable breeding and hibernation sites for pikas and ground squirrels, they contain no vegetation. Thus, the suitability of these areas with respect to food resources is low for all ROCs evaluated in this study. Based on the lines of evidence, risks to ROC populations from the waste rock piles or tailings impoundment area were considered negligible.

7.3.6 Uncertainties

Four principle areas of uncertainty were identified. These include natural variability in the ecological measures, model uncertainty, measurement error, and data errors.

Natural variability is both spatial and temporal. Only spatial variability was addressed in the assessment because only one field season of data was collected. Spatial variability reflects variation within and between habitat types.

Model uncertainty refers to models such as the HQ calculations. High uncertainty exists in the calculation of HQs because of wide variation of COPEC concentrations across each study site, unknown exposure time for each receptor within an exposure category, unknown bioaccumulation factors, assumed diet composition of receptors, assumed food ingestion rates, derived NOAELs and LOAELs, and limited toxicity and measured site data for various COPECs.

Specifically, inputs such as soil moisture contribute to high uncertainty. In general, soil is assumed to be in dry weight. For the purposes of this assessment, soil was converted to wet weight using a soil moisture of 50 percent. This value was noted to be estimated from field soil moisture measurements and is unusually high. This will likely underestimate risk. Similarly, toxicity values from various studies were averaged to obtain the mammalian NOAELs and LOAELs for arsenic and cobalt as well as avian NOAELs and LOAELs for arsenic used in the HQ calculations. Avian NOAELs and LOAELs for copper and cobalt, however, were based on single studies. This procedure may underestimate or overestimate risk.

Uncertainty also exists within the relative amount of data, measurement error, and data errors. Data sets differed in breadth; consequently, some areas had more robust data sets than other sites evaluated in the risk assessment. Measurement error was minimized by using Standard Operating Procedures, as were data errors by using a quality control procedure.

7.4 Summary of Risks

An overall summary of the risk is presented in Table 7-13 by media and whether there is a potentially unacceptable risk for human, aquatic, or terrestrial receptors for each drainage. An "X" on the table indicates a potential risk has been shown for that media and receptor group.

Table 7-13
Summary of Areas of Unacceptable Risk

Drainage	Media	HHRA	Aquatics	Terrestrial
Blackbird Creek	Soil	X (As)	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-
	Groundwater	X (As, Co)		
	Stability/Recontamination issues	X	X	-
Panther Creek	Soil	X (As)	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-
Bucktail Creek	Soil	-	-	-
	In-stream Sediments	-	-	-
	Surface Water	-	-	-
	Groundwater	X (Co, Cu)		
Big Deer Creek	Soil	-	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-
South Fork of Big Deer	Soil	-	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-

SECTION 8

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) consist of medium-specific or location-specific goals for protecting human health and the environment. This section presents the RAOs for soil, groundwater, surface water, and sediment at the Blackbird Mine site. It outlines the risks identified in Section 7 and provides the basis for evaluating the cleanup options presented in Section 9.

8.1 NEED FOR REMEDIAL ACTION

The mining operations at the Blackbird Mine site have resulted in contaminated groundwater at the mine, contaminated surface water and sediments in creeks at and downstream from the mine, and contaminated overbank deposits along creeks downstream from the mine including Blackbird Creek and Panther Creek. Key COCs at the Blackbird Mine site identified in the human health and ecological risk assessment include arsenic for human health concerns; copper and cobalt for aquatic organisms in surface water; and copper, cobalt and arsenic for aquatic organisms in sediments. Based on the results of the Human Health Risk Assessment and the Aquatic Ecological Risk Assessment, the response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

The cleanup levels (i.e., remediation goals) are driven by either background, ARARs, or risk based concentrations. The NCP states that remediation goals shall establish acceptable exposure levels that are protective of human health and the environment and shall be developed by considering the following:

> Applicable or relevant and appropriate requirements under federal environmental or state environmental or facility siting laws.
>
> For systemic toxicants, acceptable risk-based exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety.
>
> For known or suspected carcinogens, acceptable risk-based exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6} using information on the relationship between dose and response.

For the Blackbird Mine site, human health cleanup levels are based on a 1 x 10^{-4} cancer risk because there is only one carcinogenic chemical of concern (arsenic) for humans, and there is no potential for additive effects resulting from exposure to multiple chemicals. For systemic toxicants (non-cancer effects), cleanup levels are based on concentrations equal to or less than a Hazard Index of 1.

The following sections outline the remediation objective and cleanup levels for each area of the Blackbird Mine site.

8.2 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) provide a general description of what the cleanup action will accomplish. The RAOs for this site are provided in Table 8-1:

Table 8-1
Remedial Action Objectives for Blackbird Site

Media	Receptors of Concern	Remedial Action Objectives
Surface Soils	Human Receptors	Reduce direct contact (i e., ingestion and dermal contact) with surface soils containing contaminants of concern in excess of the cleanup levels. Reduce migration of surface soils and overbank deposits to downstream areas that would deposit concentrations of contaminants of concern in excess of the cleanup levels established at those downstream areas.
	Aquatic Receptors	Reduce migration of metals into the water column of the streams so that the cleanup levels for the contaminants of concern established for the streams are not exceeded Reduce migration of the surface soils to in-stream sediments so that the cleanup levels for the contaminants of concern established for in-stream sediments are not exceeded
Groundwater	Human Receptors	Prevent use of contaminated groundwater underlying waste management areas

Media	Receptors of Concern	Remedial Action Objectives
Surface Water	Human Receptors	Maintain water quality for protection of human health
	Aquatic Receptors	Reduce direct contact with surface water containing contaminants of concern in excess of the cleanup levels. Restore and maintain water quality and aquatic biota conditions capable of supporting all life stages of resident salmonids and other fishes in South Fork of Big Deer Creek and Big Deer Creek. Restore and maintain water quality and aquatic biota conditions capable of supporting all life stages of resident and anadromous salmonids and other fishes in Panther Creek. Reduce concentrations of contaminants of concern in Blackbird Creek to improve water quality such that cleanup levels are not exceeded in Panther Creek and to support some aquatic life in Blackbird Creek Reduce concentrations of contaminants of concern in Bucktail Creek to improve water quality such that cleanup levels are not exceeded in South Fork of Big Deer and Big Deer Creeks
Sediments	Aquatic Receptors	Reduce direct contact with in-stream sediments containing contaminants of concern in excess of the cleanup levels. Reduce migration of in-stream sediments to downstream areas so that the cleanup levels for the contaminants of concern established for in-stream sediments at those downstream areas are not exceeded Restore and maintain sediment quality and aquatic biota conditions capable of supporting all life stages of resident salmonids and other fishes in South Fork of Big Deer Creek and Big Deer Creek. Restore and maintain sediment quality and aquatic biota conditions capable of supporting all life stages of resident and anadromous salmonids and other fishes in Panther Creek. Reduce concentrations of contaminants of concern in Blackbird Creek to improve sediment quality such that cleanup levels are not exceeded in Panther Creek and to support some aquatic life in Blackbird Creek. Reduce concentrations of contaminants of concern in Bucktail Creek to improve sediment quality such that cleanup levels are not exceeded in South Fork of Big Deer and Big Deer Creeks

8.3 CLEANUP LEVELS

8.3.1 Human Health Cleanup Levels For Surface Soils and In-stream Sediments

The primary contaminant of concern for human health at this Site is arsenic. As discussed in Section 7, the risks to human health from arsenic were evaluated based on knowledge of current and projected future use scenarios for each area of the site. The different use scenarios ranging from recreational to residential result in different cleanup levels which are discussed below.

8.3.1.1 Upper Blackbird Creek and Lower Blackbird Creek to Panther Creek Road

As noted in Section 7, there are localized areas of soil along Blackbird Creek that have concentrations of arsenic more than an order of magnitude greater than the upper-bound average concentrations used as the EPCs in the risk calculations (e.g., concentrations of arsenic up to 138,000 milligrams per kilogram [mg/kg]). If receptors limit their activities to localized areas with unusually high concentrations of arsenic and do not spend time over the entire exposure area, there may be unacceptable potential acute (short-term) or chronic (long-term) risks associated with their exposure to the localized areas.

In addition, there are significant quantities of materials in overbank deposits and other material in Blackbird Creek channel containing elevated levels of arsenic that could become mobilized during high flow events, transported downstream and potentially deposited in recreational and residential use areas (particularly along Panther Creek).

The remedial action objective for protection of human health for this portion of Blackbird Creek is to reduce exposure to soils in areas of localized, elevated concentrations of arsenic in soil along Blackbird Creek and to reduce the threat to downstream receptors of concern from mobilization and deposition of material in downstream areas.

The cleanup levels for arsenic in soil were calculated using a risk-based analysis for a recreational scenario for the Upper and Lower Blackbird Creek exposure areas. The cleanup levels are based on a combination of standard default exposure assumptions and site-specific adjustments. The cleanup levels are based on incidental ingestion, inhalation of soil particulates, and dermal contact exposure routes (see Table 8-2). The cleanup levels are based on non-cancer effects for the child recreational use scenario because it is more protective than cleanup levels based on cancer risk. The cleanup level for arsenic based on non-cancer effects for the child scenario is 4,300 mg/kg (for 14 days per year and 2 hours per day of exposure) for Lower Blackbird Creek, and 8,500 mg/kg (for 7 days per year and 2 hours per day of exposure) for Upper Blackbird Creek. The exposure frequency is based on site-specific conditions and interviews with local residents and Forest Service staff. Blackbird Creek has limited use, and access to Blackbird Creek above the West Fork Tailings Impoundment is controlled with a gate.

8.3.1.2 Blackbird Creek Downstream from Panther Creek Road

The area along Blackbird Creek, between the existing berms adjacent to the Panther Creek Inn, between the Panther Creek road bridge and the Blackbird/Panther Creek confluence, contains overbank materials and in-stream sediments with elevated arsenic concentrations. The Panther Creek Inn has year-round residents; therefore, risk-based soil and in-stream sediment cleanup levels are based on residential use.

The risk estimate for the in-stream sediments exceed EPA's acceptable risk level for non-cancer effects with a Hazard Index of 3. In addition, several surface soil samples collected along the banks of Blackbird Creek channel (i.e., overbank deposits) in the vicinity of the Panther Creek Inn, inside the berm, have elevated arsenic. Potential risks associated with exposure to the soils between the berms were shown to be 7×10^{-4} to 2×10^{-3} for cancer risks and Hazard Indices ranging from 3 to 30 for non-cancer effects.

For the overbank deposits, the cleanup level is 100 mg/kg arsenic, which is based on background concentrations of arsenic in soil. The calculated risk based residential cleanup level for arsenic is 42 mg/kg for arsenic, which would be below naturally occurring background levels.

Cleanup levels were also developed for potential exposure to contaminated sediment in Blackbird Creek adjacent to the Panther Creek Inn by adult and child residents. The cleanup levels are based on the residential exposure scenario for an adult or a child playing in the in-stream sediments and assumes the following exposure routes: incidental ingestion, inhalation of sediment (soil) particulates, and dermal contact exposure routes. The arsenic cleanup level was developed using age-adjusted factors (i.e., parameters based on an adult and a child receptor) to address carcinogenic effects and child factors to address noncarcinogenic effects. These factors result in the most protective cleanup level (i.e., lowest values) for cancer and non-cancer effects, respectively. The cleanup level calculations for the non-cancer effects results in the lowest of these values, 488 mg/kg. Rounding up, a value of 490 mg/kg arsenic is selected as the cleanup level for in-stream sediments in Blackbird Creek between the Panther Creek Road bridge and the confluence of Panther Creek.

8.3.1.3 Panther Creek

Four private properties along Panther Creek ([redacted] 2, [redacted] 3, [redacted] and [redacted] pasture) exceed EPA's acceptable risk range for the future residential scenario. Risk estimates for the [redacted] property also exceed EPA's acceptable range for the full-time resident, but is based on a limited data set. The property owner denied access for further sampling. The residential use cleanup level of 100 mg/kg arsenic is used for overbank soils based on background concentrations of arsenic in soil.

8.3.2 Human Health Cleanup Levels For Groundwater

The primary contaminant of concern in the groundwater for protection of human health at this Site is arsenic as well as risk-based concentrations of copper and cobalt. As discussed in Sections 5 and 7, there are areas within the Site where groundwater levels exceed the Maximum Contaminant Level (MCL) of 10 ug/L for arsenic. Although the MCL establishes threshold contaminant levels for community drinking water systems and, as such, is not applicable to this Site, the MCL is relevant and appropriate in considering cleanup levels for groundwater.

(55 Fed. Reg. 8753, March 8, 1990) The cleanup levels for copper and cobalt are 3,060 ug/L and 1,530 ug/L, respectively, and are based on an HI of 1 for non-cancer effects. The cleanup levels are based on site-specific assumptions for worker exposure (167 days per year assuming drinking 2 liters of water per day).

CERCLA and the NCP provide that groundwater should be returned to its beneficial uses within a reasonable timeframe wherever practicable. When restoration of groundwater is not practicable, then it is necessary to prevent further migration of the plume and to prevent exposure to the contaminated groundwater. 40 C.F.R.300.430(a)(2). The NCP provides that groundwater cleanup levels should generally be attained throughout the contaminated plume. However, the NCP recognizes that groundwater may remain contaminated at and beyond the edge of the waste management area when waste is left in place (55 Fed. Reg. 8712, 8753, March 8, 1990).

8.3.2.1 Upper Blackbird Creek and Lower Blackbird Creek to Panther Creek Road

The Blackbird Creek drainage and the West Fork Tailings Impoundment have elevated levels of arsenic in the groundwater that exceed the MCL and risk-based concentrations of copper and cobalt. Since the groundwater in most of the Blackbird Creek drainage is underlying waste management areas where tailings and other materials are being managed, the point of compliance for groundwater will be beyond this area downgradient of the Panther Creek Road.

Groundwater that discharges through seeps or springs that adversely impacts surface water must be managed so that the cleanup levels for surface water for protection of human health and the environment will be met in the surface water.

8.3.2.2 Blackbird Creek Downstream from Panther Creek Road

The Panther Creek Inn drinking water wells have not shown elevated levels of mine-related arsenic, copper or cobalt. However, to the extent that groundwater in this area is contaminated by mine related activities and is a potential source of drinking water, it must be cleaned up to meet MCLs for arsenic and risk-based cleanup levels for copper and cobalt.

Groundwater that discharges through seeps or springs that adversely impacts surface water must be managed so that the cleanup levels for surface water for protection of human health and the environment will be met in the surface water.

8.3.2.3 Panther Creek

The Panther Creek drinking water wells have not shown elevated levels of mine-related arsenic, copper or cobalt. However, to the extent that groundwater in this area is contaminated by mine related activities and is a potential source of drinking water, it must be cleaned up to meet MCLs for arsenic and risk-based cleanup levels for copper and cobalt.

Groundwater that discharges through seeps or springs that adversely impacts surface water must be managed so that the cleanup levels for surface water for protection of human health and the environment will be met in the surface water.

8.3.3 Human Health and Aquatic Cleanup Levels for Surface Water

The cleanup levels for arsenic, copper and iron in surface water are based on standards established under applicable or relevant and appropriate requirements (ARARs). The cleanup levels for cobalt are derived from a risk-based analysis.

Surface Water Cleanup Levels Derived From ARARs

Section 121 of CERCLA, 42 U.S.C. Section 9621(d), requires attainment of Federal and State ARARs. "Applicable requirements" are those requirements that specifically address a hazardous substance remedial action, location or other circumstance found at the Site. (40 C.F.R. 300.5) "Relevant and appropriate requirements" are those requirements that, while not "applicable", address problems or situations sufficiently similar to those at the Site that their use is well suited to the Site. (40 C.F.R. 300.5)

Section 121(d)(2)(A) of CERCLA, 42 U.S.C. § 9621(d)(2)(A), specifically identifies the water quality criteria established under section 303 or 304 of the Clean Water Act (CWA) as potentially relevant and appropriate depending on the circumstances of the release or threatened release. To determine whether or not the water quality criteria under the Clean Water Act is relevant and appropriate under the circumstances of the release or threatened release, EPA is required to consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available. (42 U.S.C. §9621(d)(2)(B)(i))

For the contaminants of concern at this Site, the State of Idaho standards differ from the current Clean Water Act ambient water quality criteria. To reconcile this difference, the following discussion identifies the available Idaho standards as "applicable" and considers the federal ambient water quality criteria (AWQC) established under the Clean Water Act to determine whether it is relevant and appropriate to the circumstances of the release.

Arsenic Cleanup Level

The State of Idaho has established a water quality standard for arsenic of 50 μg/L for protection of human health and the environment. This standard is applicable to the surface water at this

Site. In addition, EPA has determined that the Federal AWQC is relevant and appropriate for evaluating surface water quality for protection of human health at a 10^{-4} risk level based on "consumption of organisms only" in those creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big Deer Creek and Big Deer Creek).

In reaching this decision, EPA reviewed the 2002 National Recommended Water Quality Criteria which establish two separate values for the protection of human health: (1) when contaminated organisms and water are consumed, 2) when contaminated organisms are consumed.

First, EPA reviewed the AWQC for protection of human health based on "consumption of water and organisms" and found that this AWQC is not relevant and appropriate based on the site-specific human health risk assessment. The Blackbird Mine Site Human Health Risk Assessment found that recreational contact to and ingestion of surface waters in the creeks containing elevated levels of arsenic does not present an unacceptable risk to recreational visitors or workers at the mine.

Second, EPA reviewed the Federal AWQC for protection of human health based on "consumption of organisms only" and found that the AWQC of 14 ug/L for arsenic is potentially relevant and appropriate for the purposes of reducing risk of human exposure based on consumption of organisms in Panther Creek, South Fork Big Deer Creek and Big Deer Creek. However, the AWQC is not currently relevant and appropriate for Blackbird Creek and Bucktail Creek since these creek are not presently protected for aquatic life.

Since Panther Creek, Big Deer Creek and South Fork Big Deer Creek are protected for aquatic life, the AWQC of 14 ug/L for arsenic is relevant and appropriate. EPA has reviewed the post-Early Action surface water monitoring data for Panther Creek, Big Deer Creek and South Fork Big Deer Creek to determine whether these creeks meet this criteria. There have been occasional exceedances of the arsenic AWQC criterion of 14 ug/L for the unfiltered samples in Panther Creek and South Fork Big Deer Creek. There have been no exceedances of the arsenic AWQC criterion in Big Deer Creek. For Panther Creek and South Fork Big Deer Creek, EPA applied a 95% UCL to the unfiltered sample data and concluded that the 95% UCLs for both Panther Creek and South Fork Big Deer Creek do not exceed the AWQC criteria of 14 ug/L.

The surface water cleanup level for arsenic in Panther Creek, Big Deer Creek and South Fork Big Deer Creek is 14ug/L. The surface water cleanup level for arsenic in Blackbird Creek is 50 μg/L. There is no surface water cleanup level for arsenic in Bucktail Creek.

Copper Cleanup Level

The State of Idaho has adopted water quality standards for copper for protection of aquatic life. This standard is listed in IDAPA 58.01/02.210. This standard is applicable to the surface water at this Site.

Based on its evaluation of the elements set forth above and the limited information that is available, EPA has determined that the AWQC is not currently relevant and appropriate for copper under the circumstances of the release at this site. This decision is based on information provided by the State of Idaho in their comments on the Proposed Plan which included 1) a review of several studies of the effects of copper toxicity test to relevant species which would occur at the Site and 2) a literature review of salmonid copper toxicity tests which indicates that the Idaho copper criteria would be protective of the coldwater aquatic life at the Site. EPA may re-evaluate this determination during the five year review process.

For this Site, the difference between the AWQC and the Idaho WQS is most apparent in streams where the hardness is below 25 mg/L CaCO3 such as in Big Deer Creek. For those streams such as Panther Creek whose hardness values are at or above 25 mg/L, there is little difference between the 1999 AWQC and the Idaho copper standard.

The Idaho WQS currently has a cap at a low end hardness value of 25 mg/L. Therefore, when the ambient hardness is lower than 25mg/L, the Idaho WQS is still calculated using a hardness value of 25 mg/L. The following tables provide the equations for calculating the Idaho water quality standard for copper and show the values that are derived from the equations over the range of hardness found at the Site.

Table 8-3
Hardness-dependent Aquatic Life Criteria for Dissolved Copper in Idaho

Metal	CMC Equation (μg/L)	CCC Equation (μg/L)
Copper	CMC = $0.960 \times e^{(0.9422 \times \ln(\text{hardness}) - 1.464)}$	CCC = $0.960 \times e^{(0.8545 \times \ln(\text{hardness}) - 1.465)}$

Source: IDAPA 58 0102 210

CMC is the 1-hour average concentration that is not to be exceeded more than once in a three-year period

CCC is the 4-day average concentration that is not to be exceeded more than once in a three-year period.

Table 8-4 Criteria Calculated Over a Range of Hardness Values That Commonly Occur in the Blackbird Mine Site								
Metal	CMC (µg/L)				CCC (µg/L)			
Hardness (mg/L)	25	30	50	100	25	30	50	100
Copper	4.6	5.5	8.9	17.0	3.5	4.1	6.3	11.4

Iron

Based on its evaluation of the elements set forth above, EPA has also determined that the AWQC is not relevant and appropriate for iron based on the circumstances of the release at this site. This decision is based on a review of the iron criterion (which was promulgated in 1976) and more recent scientific publications on the ecotoxicity of iron. (Feasibility Study Appendix C). As a result, EPA has not established a cleanup level for iron in surface water.

<u>Surface Water Cleanup Levels Derived From Risk-Based Analysis</u>

For cobalt, there is no existing Federal national ambient water quality criterion (AWQC) nor Idaho WQS. Therefore, the cobalt cleanup level in surface water is risk-based.

In the absence of an established State WQS and AWQC, a weight of evidence approach was used to select an appropriate toxicity reference value (TRV) which was used to establish the cleanup level for cobalt. Available literature data, site-specific testing data, and screening criteria were all considered. The goal of the TRV selection process was to establish a cobalt TRV protective of individual threatened or endangered salmonids, and to be protective of populations of all other aquatic life. Although the available data are limited, there are sufficient studies by which to establish the toxicity of cobalt to aquatic life and salmonids.
The cobalt cleanup level considered the following types of information:

- The available federal, state, and other governmental criteria or guidelines; however, these are influenced by Daphnia values and are likely overly conservative;

- Published studies with invertebrates and fish, particularly studies with species likely to occur in Blackbird/Panther Creek drainages;

- Site specific data.

Salmonid-specific studies were used in development of the salmonid cleanup level. The most appropriate values are chronic (i.e., long-term) studies, resulting in a mortality, morbidity, or reproductive "no effects" endpoint. A no observed effect concentration (NOEC) endpoint is likely to be protective of both populations and individuals in the field. The existing salmonid NOECs from site-specific data were short-term (14 days) or had methodology problems (i.e., used resistant strain of trout). Therefore, a value protective of threatened salmonids would have to be lower than the measured site-specific NOECs. The toxicity values used to develop the cleanup level are presented in Table 8-3. It is important to note that all of the salmonid TRVs in Table 8-5 are similar, although they are derived from different sources and by different methods. Because all of the TRVs are so similar, a median value is appropriate for the cobalt TRV. The median represents the 50th percentile and, as a statistic, is resistant to the effects of outliers; because the TRVs converge toward a value between 0.3 and 0.4 mg/L, the uncertainty in the cobalt TRV is less than in any of the studies individually.

The cleanup level for cobalt for all salmonid species is 0.038 mg/L. This value should be adequately protective of individual special status salmonids, since it incorporates the chronic NOEC and other data. It should be adequately protective of populations of salmonids as well. This value is expected to be adequately protective, but not overly conservative.

Table 8-5
Summary of Salmonid Cobalt TRVs

Endpoint	Co (mg/L)	Source	UF	Co TRV (mg/L)
LC01	0.038	Birge et al., 1980	None	0.038
LC01	0.034	Birge et al., 1978	None	0.034
28-d LC50	0.47	Birge et al., 1978	ACR	0.041
28-d LC50	0.49	Birge et al., 1980	ACR	0.043
60-d NOEC	0.213	HydroQual, 1996	6	0.036
14-d NOEC	0.125	RCG Hagler Bailly (1995)	6	0.021
96-h LC20	0.533	RCG Hagler Bailly (1995)	ACR	0.046
Median				0.038

Note Site-specific ACR = 11 5 HydroQual, 1999
mg/L values are dissolved
UF = uncertainty factor

8.3.3.1 Blackbird Creek

The State of Idaho has determined that Blackbird Creek and its tributaries should be protected for a beneficial use of secondary contact recreation. In 1997, the State of Idaho completed a use attainability analysis (UAA) and removed the beneficial use designation for aquatic life. EPA has reviewed and approved this use attainability analysis. As a result, there is not a State water quality standard for aquatic life in Blackbird Creek. A review of the secondary contact recreation standards (IDAPA 58.01.02) indicates that arsenic is the only contaminant at the site that could be of concern. The State's secondary contact recreation standard is for dissolved arsenic and is 50 $\mu g/L$. A non-numeric narrative cleanup goal is provided below for copper and cobalt instead of a numeric cleanup level.

> *The remedial goal for Blackbird Creek is to improve water and sediment quality such that cleanup levels are not exceeded downstream in Panther Creek. In addition, the remedial goal for Blackbird Creek is to support aquatic life at levels similar to that of nearby reference streams, although not necessarily to support salmonids or metals-sensitive macroinvertebrate taxa.*

8.3.3.2 Bucktail Creek

The State of Idaho has performed a use attainability analysis for Bucktail Creek which removed the beneficial use designations for aquatic life and recreation from this segment. EPA has reviewed and approved this use attainability analysis. As noted in the use attainability analysis, Bucktail Creek is too small to have any real likelihood of contact recreation such as wading, fishing, and swimming. Physical conditions related to the natural features of Bucktail Creek, such as steep gradient and small size and flow, likely precluded its pre-mining use by fish. In addition, limited habitat conditions result in minimum potential for significant contribution of benthic invertebrates to the overall food supply in the Big Deer Creek drainage. Therefore, a non-numeric cleanup level for Bucktail Creek is provided below.

> *The remedial goal for Bucktail Creek is to improve water and sediment quality such that cleanup levels are not exceeded downstream in South Fork Big Deer Creek or in Big Deer Creek.*

8.3.3.3 South Fork of Big Deer, Big Deer and Panther Creeks

The surface water cleanup levels for the protection of aquatic life in South Fork of Big Deer Creek, Big Deer Creek and Panther Creek are a combination of the ARAR for copper and a risk-based weight of evidence approach for cobalt in surface water and copper and cobalt in sediments.

The surface water cleanup levels established for copper, cobalt and arsenic must be met in South Fork of Big Deer Creek, Big Deer Creek and Panther Creek. In accordance with the Clean Water Act and the State of Idaho Water Quality Standards, point source discharges may allow a mixing zone. A mixing zone is an allocated impact zone where the cleanup levels can be exceeded. The Idaho Water Quality Standards provide the criteria for evaluating the size, configuration and location of a mixing zone. This evaluation includes a determination that the mixing zone does not cause unreasonable interference with or danger to beneficial uses and provides guidance regarding the size of the mixing zone. (IWQS 58.01.02.060). Monitoring is necessary to ensure that the mixing zone does not interfere with beneficial uses.

For the purposes of meeting water cleanup levels for copper and cobalt in Panther Creek, a mixing zone has been established at the confluence with Blackbird Creek for the remedy selected in this ROD. This mixing zone has been developed as part of the applicable National Pollutant Discharge Elimination System (NPDES) requirements for establishing effluent limitations for the point source discharges from the water treatment plant and the West Fork Tailings Impoundment. The effluent limitations for these point sources must take into consideration the potential impacts to water quality in Panther Creek which is protected for aquatic life. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

For the purposes of meeting the cleanup level for copper in Big Deer Creek, a mixing zone has been established for the discharge of diverted surface water from Bucktail Creek for the selected remedy in this ROD. This mixing zone has been developed as a relevant and appropriate NPDES requirement. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

8.3.4 Aquatic Cleanup Levels For Sediments In Panther Creek, Big Deer Creek and South Fork of Big Deer Creek

This section describes the toxicity criteria and exposure assumptions used to calculate the sediment cleanup levels for the protection of aquatic life in Panther Creek, Big Deer Creek and South Fork of Big Deer Creek. Benthic invertebrates dwell within the sediments and form the basis of the aquatic food web. Salmonids and other fish lay eggs in sediments. Metals are known to be toxic to benthic invertebrates, and may be toxic to salmonid eggs. Resuspended sediments serve as a potential source of exposure because fish and invertebrates can then ingest them from the water column during feeding.

Aquatic receptors consisting of anadromous and resident salmonids, other fish, and benthic invertebrates could inhabit Panther Creek in the absence of metal contamination from the Blackbird Mine site. Consequently, sediment cleanup levels for aquatic life were established for Panther Creek by considering bioaccumulation, toxicity, and background conditions.

A weight of evidence approach was taken in establishing sediment cleanup levels. A dietary cleanup level, toxicity-based probable effects concentration (PEC), and background concentrations were considered in establishing the sediment cleanup level. If the background concentration falls above the toxicity-based PEC or dietary cleanup level, background is the cleanup level. If background falls below the toxicity-based PEC or dietary cleanup level, the PEC is the cleanup level.

The sediment cleanup levels are presented in Table 8-6 below.

Table 8-6 Sediment Cleanup Levels for Big Deer and Panther Creeks				
COPEC	Background (mg/kg)	Dietary Level (mg/kg)	PEC (mg/kg)	Cleanup Level (mg/kg)
Arsenic	34.8	76.29	33	34.8
Cobalt	39	No TRV; PRG cannot be determined	Cannot be determined; site-specific data suggest 80.3	80
Copper	637	536.5	149	637

Note All values are in mg/kg dry weight.

South Fork of Big Deer Creek has different background concentrations and the sediment clean up levels are presented in Table 8-7.

Table 8-7 Sediment Cleanup Levels for South Fork of Big Deer Creek				
COPEC	Background (mg/kg)	Dietary Level (mg/kg)	PEC (mg/kg)	Cleanup Level (mg/kg)
Arsenic	34.8	76.29	33	34.8
Cobalt	436	No TRV; PRG cannot be determined	Cannot be determined; site-specific data suggest 80 3	435
Copper	637	536.5	149	637

Note· All values are in mg/kg dry weight

Below is a summary table of the cleanup levels for each creek.

Table 8-8
Summary of Sediment and Surface Water Health and Aquatic Life Cleanup Levels by Drainage

Drainage	Media	Arsenic	Cobalt	Copper
Panther Creek	In-stream Sediments	35 mg/kg	80 mg/kg	149 mg/kg
	Surface Water	0.014 mg/l	0.038 mg/l	IWQS
South Fork of Big Deer Creek	In-stream Sediments	35 mg/kg	436 mg/kg	637 mg/kg
	Surface Water	0.014 mg/l	0.038 mg/l	IWQS
Big Deer Creek	In-stream Sediments	35 mg/kg	80 mg/kg	149 mg/kg
	Surface Water	0 014 mg/l	0 038 mg/l	IWQS
Blackbird Creek	In-stream Sediments	See Narrative Goal	See Narrative Goal	See Narrative Goal
	Surface Water	0.050 mg/l	See Narrative Goal	See Narrative Goal
Bucktail Creek	In-stream Sediments	See Narrative Goal	See Narrative Goal	See Narrative Goal
	Surface Water	See Narrative Goal	See Narrative Goal	See Narrative Goal

Note: All values are in mg/kg dry weight
The values for surface water mg/l are dissolved except for arsenic which is total

SECTION 9

DESCRIPTION OF ALTERNATIVES

Many technologies were considered to clean up the Blackbird Mine site. Appropriate technologies were identified and screened for applicability to site conditions. The potential technologies were then assembled into alternatives. Potential remedial alternatives for the Blackbird Mine site were identified, screened, and evaluated in the Feasibility Study (FS). The range of alternatives developed included no action, institutional controls, containment, treatment, and disposal. The alternatives are identified by numbers used in the FS. The alternatives are numbered to correspond with the numbers in the FS Report. The numbers are not sequential because they are the alternatives that were carried forward to the detailed analysis and the other alternatives were screened out earlier in the FS report.

Because the Blackbird Mine affects three different drainages, the alternatives for the Blackbird Mine Site have been divided into the following remediation areas:

- Blackbird Creek: this area includes sources and affected surface water, groundwater, overbank deposits and in-stream sediments in Meadow Creek, Blackbird Creek and the West Fork Tailings Impoundment;

- Bucktail Creek: this area includes sources and affected surface water, groundwater, and in-stream sediments in Bucktail Creek, South Fork of Big Deer and Big Deer Creek;

- Panther Creek: this area includes overbank deposits on Panther Creek and in-stream sediments in Panther Creek.

The Blackbird Creek and Bucktail Creek alternatives address sources that affect water quality and sediments in tributaries in their respective drainages as well as water quality and sediments downstream in Panther Creek

<u>BLACKBIRD CREEK DRAINAGE ALTERNATIVES</u>

9.1 COMMON ELEMENTS OF EACH BLACKBIRD CREEK DRAINAGE ALTERNATIVE

The following elements are included in all of the Blackbird Creek drainage alternatives except the No Further Action alternative.

- Institutional controls (ICs) will be required for all alternatives. ICs are legal and administrative measures such as easements, restrictive covenants and enforcement tools. The ICs will preclude activities that would interfere with the remedy. In addition, ICs will be implemented to prevent the use of groundwater as drinking water for groundwater underlying the waste management areas in the Blackbird Creek drainage.

- Physical restrictions include gates to restrict vehicle traffic and fencing. There is currently a gate located on the Blackbird Creek road a short distance upstream of the Ludwig Gulch Road, which restricts vehicular access to most of the mine area.

- Continued operation of the existing lime precipitation and air oxidation water treatment plant to treat copper and cobalt in water collected by the Early Actions and for treatment of additional contaminated water collected as part of the Remedial Actions.

- Removal of overbank deposits along Blackbird Creek and in-stream sediments adjacent to the PCI that are above cleanup levels. The area would be periodically monitored to determine if it has become recontaminated, and additional removal conducted if future monitoring determines that there is an unacceptable risk to human health.

- Meadow Creek seep collection includes revising the drainage systems in upper Meadow Creek to collect contaminated water and treat the water that was not intercepted as part of the Early Actions at the existing water treatment plant. The contaminated water will be collected behind the 7100 dam and clean water will be diverted around the dam by pipes and a ditch (see Figure 9-1). The construction of this element was started in the fall of 2002 as a modification to the Early Action.

- Soil cover on the West Fork Tailings Impoundment (see Figure 9-2). The cover material will consist of soil that was removed from the overbank deposits along Blackbird Creek and Panther Creek during the Early Actions and any overbank deposits removed from along Blackbird Creek and Panther Creek during the Remedial Actions. The cover will be graded to drain to the creek channel, and will be seeded to establish vegetation. The cover will reduce the amount of cobalt that leaches from the impoundment into groundwater and downstream surface water.

- Monitoring will be required to maintain facilities, evaluate effectiveness of actions at meeting cleanup levels and to document recovery of benthic invertebrate and fish populations. In addition, monitoring will be conducted of various components of the remediation system to ensure effectiveness. This monitoring will include selected overbank areas along Panther Creek (including near the Panther Creek Inn) following significant run-off events to ensure that these areas do not exceed human health cleanup levels due to remobilization of Blackbird Creek sediments and any overbank deposits not addressed by the remedy in this ROD. Monitoring will also be conducted to evaluate whether run-off from the Tailings Impoundment has any impact on water quality. In addition, as part of the Clean Water Act, NPDES substantive requirements monitoring of the water treatment plant discharges (i.e., effluent limits) and monitoring to evaluate the protectiveness of the mixing zone analysis will be conducted. This monitoring may include but not be limited to surface water, sediments, benthic macroinvertebrates, and fish.

- Operation and maintenance of the Early Action and Remedial Action facilities.

- Natural recovery of in-stream sediments includes a variety of natural, physical, chemical and biological processes that result in the concentration of contaminants in sediments being reduced over time without taking active measures (such as dredging) to achieve cleanup levels in sediments. For example, metal concentrations are reduced by metals dissolving back to the water column, and by physical sediment transport from scouring and mobilization of fine-grained sediments until concentrations in sediments are reduced to cleanup levels. It is not possible to accurately predict how long it will take for natural recovery of in-stream sediments.

- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of the cleanup actions.

9.2 DESCRIPTION OF THE BLACKBIRD CREEK DRAINAGE ALTERNATIVES

The description of each alternative below includes a detailed description of distinguishing elements of the alternative that have not been described under common elements above.

Based on the narrative cleanup goal for Blackbird Creek, the various remediation alternatives have been developed to improve water and sediment quality in Blackbird Creek, and are evaluated for meeting cleanup levels within Panther Creek.

9.2.1 Alternative BB-1 - No Further Action

Estimated Capital Cost: $0
Estimated Operations and Maintenance Cost: $ 1.2 Million
Estimated Total Present Worth Cost: $ 1.2 Million
Estimated Construction Time Frame: None

Under this alternative no further actions would be implemented, other than the Early Actions that already have been completed. Monitoring as described under common elements, and operation and maintenance of the existing Early Action facilities would continue.

9.2.2 Alternative BB-4 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $ 2.1 Million
Estimated Operations and Maintenance Cost: $ 2 Million
Estimated Total Present Worth Cost: $ 4.2 Million
Estimated Construction Time Frame: 1 to 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also includes physical stabilization of overbank deposits by armoring with rock and limited removal of overbank deposits along Blackbird Creek (see Figure 9-3). The overbank deposits that are removed will be used in the cover at the West Fork Tailings Impoundment as described under common elements. The cover at the West Fork Tailings Impoundment would be used to address cobalt leaching from the impoundment. However, there is uncertainty concerning how long it would take to achieve the cobalt cleanup level in Panther Creek and whether the cobalt cleanup level would ever be achieved with the cover on the West Fork Tailings Impoundment. The distinguishing characteristics of this alternative include the following:

Physical Stabilization with Selective Removal of Blackbird Creek Overbank Deposits

Overbank deposits that have the potential for mobilization by the design 500-year flood would be physically stabilized against mobilization by armoring. Armoring of overbank deposits would be accomplished by placing angular riprap armor rock. The armor riprap would be installed along exposed banks of mine-related sediments from the bottom anticipated scour depth to above the water surface elevation predicted for the design flood. The armor rock would be sized to resist mobilization during the design flood. In a few selected areas (e.g., where the creek flows around a rock outcrop), armoring would be difficult and less reliable than removal. For these selected areas, overbank deposits would be removed rather than armored.

In addition to armoring, overbank deposits with arsenic concentrations above human health cleanup levels would be removed. No further action would be taken for overbank deposits in talus slopes. The talus rock already provides armoring, and removal would be difficult.

In some locations, overbank deposits are blocking overland runoff from upland watershed areas. In these areas, stormwater run-off accumulates behind the overbank deposits. In some locations, where the runoff has been unable to get around or over the deposits, the accumulated water has broken through the overbank deposits and washed out some of the deposits. To address this, where necessary, one or both of the following would be performed:

- Drainage pathways would be excavated through the piles to provide natural drainage of accumulated water, or the piles would be re-graded to minimize the potential for accumulation.

- Diversion ditches would be used to route surface water runoff around the overbank deposits.

9.2.3 Alternative BB-5 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $3.2 Million (*in-situ* passive water treatment), $ 4.7 Million (*in-situ*, pre-designed water treatment), $5.3 Million (ex-situ pump-back to existing water treatment plant)

Estimated Operations and Maintenance Cost: $3.2 Million (*in-situ* passive), $ 4.8 Million (*in-situ*, pre-designed), $ 4.5 Million (ex-situ pump-back to existing water treatment plant)

Estimated Total Present Worth Cost: $ 6.4 Million (*in-situ* passive), $ 9.5 Million (*in-situ*, pre-designed), $ 9.9 Million (ex-situ pump back to existing water treatment plant)

Estimated Construction Time Frame: 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also includes physical stabilization by armoring with rock and limited removal of overbank deposits along Blackbird Creek as in Alternative BB-4, plus collection and treatment of cobalt in groundwater seepage from the West Fork Tailings Impoundment (see Figure 9-4). The treatment of cobalt would provide for timely achievement of the cobalt cleanup level and certainty that the cleanup level would be achieved. The distinguishing characteristics of this alternative includes the collection and treatment of West Fork Tailings Impoundment seepage.

Collection and Treatment of West Fork Tailings Impoundment Seepage

The seepage from the West Fork Tailings Impoundment is high in metals, particularly cobalt. The seepage from the tailings impoundment typically accounts for over half of the cobalt loads measured at the mouth of Blackbird Creek. Under this alternative, the seepage would be intercepted and treated.

Three options are considered for treating cobalt in the water from the impoundment. The options are: pump water to the existing water treatment plant; *in-situ* treatment by installing a pre-designed (packaged) water treatment plant (e.g., lime precipitation); or *in-situ* passive treatment which could be accomplished in a variety of ways including a sorption cell, an apatite treatment bed, anaerobic sulfate-reducing bacterial (SRB) cell, a pH increasing process. All three process options include installation of groundwater interception systems. Treatability studies would be performed for both the *in-situ* treatment option and the ex-situ pre-designed water treatment plant option.

9.2.4 Alternative BB-6 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $2.7 Million
Estimated Operations and Maintenance Cost: $ 1.9 Million
Estimated Total Present Worth Cost: $ 4.6 Million
Estimated Construction Time Frame: 1 to 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also consists of primarily removing overbank deposits along Blackbird Creek with limited physical stabilization by armoring with rocks. The removal of overbank deposits would reduce the amount of copper and cobalt leaching into Blackbird and Panther Creek more than Alternative BB-4 which primarily leaves the contaminated overbank deposits in place with stabilization. The deposits that are removed would be used in the cover at the West Fork Tailings Impoundment. The cover at the West Fork Tailings Impoundment would be used to address cobalt leaching from the impoundment. However, there is uncertainty concerning how long it would take to achieve the cobalt cleanup level in Panther Creek and concerning whether the cobalt cleanup level would ever be achieved with the cover at the West Fork Tailings Impoundment (see Figure 9-5). The distinguishing characteristic of this alternative includes the removal with selective armoring of Blackbird Creek overbank deposits.

Removal with Selective Armoring of Blackbird Creek Overbank Deposits

Designated overbank deposits would be excavated and hauled to the Tailings Impoundment or the Blacktail Pit for disposal. Excavation would be conducted to the former slope or angle of repose, to natural ground surface, or to the water table as indicated for the individual deposits. Following excavation, the removal area would be graded as necessary for stormwater drainage.

Where possible, excavation and loading would be performed from the roadside (i.e., without crossing the creek). However, equipment would need to cross the creek in some locations. In these locations, direct creek crossing may be performed, or a temporary bridge constructed. Temporary bridges would be removed on completion of the work.

In a few selected areas, armoring would be used instead of removal. In addition, armoring would be added in removal areas where residual concentrations exceed the human health cleanup level, or where EPA determines that armoring is required to prevent significant remobilization of affected sediments.

No further action would be taken for overbank deposits in talus slopes. The talus rock already provides armoring, and removal would be difficult. Removal in the talus slopes would also destabilize the hillside, potentially increasing erosion of overbank deposits into the creek.

9.2.5 Alternative BB-7 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $3.7 Million (*in-situ* passive), $ 5.2 Million (*in-situ*, pre-designed), $5.3 Million (ex-situ pump-back to existing water treatment plant)

Estimated Operations and Maintenance Cost: $3 Million (*in-situ* passive), $ 4.5 Million (in-situ, pre-designed), $ 4.4 Million (ex-situ pump-back to existing water treatment plant)

Estimated Total Present Worth Cost: $ 6.8 Million (*in-situ* passive), $ 9.9 Million (*in-situ*, pre-designed), $ 10.3 Million (ex-situ pump back to existing water treatment plant)

Estimated Construction Time Frame: 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also consists of primarily removing overbank deposits along Blackbird Creek with limited physical stabilization by armoring with rocks as in Alternative BB-6 plus collection and treatment of cobalt in water from the West Fork Tailings Impoundment as described under Alternative BB-5 (see Figure 9-6). The treatment of cobalt would provide for timely achievement of the cobalt cleanup level and certainty that the cleanup level would be achieved.

9.2.6 Alternative BB-8 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Complete Removal of Overbank Deposits and In-Stream Sediments

Estimated Capital Cost: $ 49.1 Million (passive), $ 50.5 Million (*in-situ*, pre-designed), $ 51.2 Million (*in-situ* pump-back to existing water treatment plant)

Estimated Operations and Maintenance Cost: $ 3.7 Million (*in-situ* passive), $ 5.3 Million (in-situ, pre-designed), $ 5 Million (ex-situ pump-back to existing water treatment plant)

Estimated Total Present Worth Cost: $ 52.7 Million (*in-situ* passive), $ 55.8 Million (*in-situ*, pre-designed), $ 56 Million (ex-situ pump back to existing water treatment plant)

Estimated Construction Time Frame: 2 years

This alternative contains all the elements that are described above under the common elements and includes treatment at the West Fork Tailings Impoundment as described under Alternative BB-5. This alternative differs from the other Blackbird Creek alternatives in that it includes complete removal of both overbank deposits and in-stream sediments in Blackbird Creek (see Figure 9-7). Removal would extend from the existing road to the valley wall across from the road. Because separation of natural and mine-related in-stream sediments is not practical, all sediments in the stream channel would be removed to bedrock including sediments below the water table. The removed material would be placed at a new disposal repository in the mine site area. Following excavation, sufficient backfill would be placed in and around the stream channels to provide riparian habitat, and the backfill would be revegetated.

BUCKTAIL CREEK DRAINAGE ALTERNATIVES

9.3 COMMON ELEMENTS FOR EACH BUCKTAIL CREEK DRAINAGE ALTERNATIVE

The following elements are included in all of the Bucktail Creek drainage alternatives, except the No Further Action alternative:

- Institutional controls
- Monitoring
- Continued operation of the existing wastewater treatment plant as described under Blackbird Creek alternatives
- Construction of contaminated groundwater and seep collection facilities in Bucktail Creek (Phase 1 Bucktail Creek Facitities as described in the FS) was begun in the fall of 2002 as a modification to the Early Action
- Operation and maintenance of all facilities
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of the cleanup actions

9.4 DESCRIPTION OF THE BUCKTAIL CREEK DRAINAGE ALTERNATIVES

The description of each alternative below includes a detailed description of distinguishing elements of the alternative that have not been described under common elements above or in a previous alternative.

Based on the narrative cleanup goal for Bucktail Creek, the various remediation alternatives have been developed to improve water and sediment quality in Bucktail Creek, and are evaluated for meeting cleanup levels within South Fork Big Deer, Big Deer, and Panther Creeks. Predictions of copper and cobalt concentrations were not performed for impacts of the Bucktail Creek Alternatives on Panther Creek. This is because the goal of the Bucktail Creek alternatives is to meet water quality cleanup levels in Big Deer Creek. Assuming that water quality cleanup levels are met in Big Deer Creek, there would be no negative impacts on Panther Creek waters. The estimates do not include any improvements due to natural recovery of sediments.

9.4.1 Alternative BT-1 – No Further Action

Estimated Capital Cost: $0
Estimated Annual Operations and Maintenance Cost: $ 1.2 Million
Estimated Present Worth Cost: $ 1.2 Million
Estimated Construction Time Frame: None

Under this alternative, no further actions would be implemented, other than the Early Actions that already have been completed. Monitoring, and operations and maintenance of the existing Early Action facilities would continue.

9.4.2 Alternative BT-3 – Seep Collection and Treatment; Natural Recovery of Sediments

Estimated Capital Cost: $ 2 Million
Estimated Annual Operations and Maintenance Cost: $ 2.4 Million
Estimated Present Worth Cost: $ 4.4 Million
Estimated Construction Time Frame: 2 years

This alternative provides groundwater seep collection and treatment. Groundwater seeping into Bucktail Creek below the 7000 dam would be intercepted and pumped back for treatment at the existing water treatment plant or treated at a passive *in-situ* facility (e.g., a sorption wall). Seeps have been observed entering the creek upstream of the upper sediment pond and in an area upstream of BTSW-01.6. The primary source of seepage is believed to be immediately below the 7000 dam and an area around BTSP-01. There may be other, yet unidentified, sources of seepage containing metals. This alternative would involve installation of one or more interception trenches to collect affected groundwater (see Figure 9-8).

Initially, one groundwater cutoff wall and a seep collection system would be installed below the 7000 dam. Collected water would flow by gravity to the existing pump-back station, pumped to the 6930 adit, then routed through the mine workings to the existing wastewater treatment plant in the Blackbird Creek drainage. The construction of this element was started in the fall of 2002 as a modification to the Early Action.

After construction of the initial seepage collection with the groundwater cutoff wall and seep collection system, additional seepage collection would be implemented downstream (unless it is determined unnecessary after the initial seepage collection system is constructed). Gravel would be placed in the creek bed to create a gravel drain, and a surface water channel constructed above the gravel. The intent would be to provide a clean water flow channel for stormwater, and to separately collect and treat the underlying seepage. If the metal loads in the groundwater were relatively low, then passive *in-situ* treatment (e.g., a sorption wall) would be considered. If the metal loads were too high for cost-effective *in-situ* treatment, a second groundwater cutoff wall would be installed downstream from BTSP-01 to intercept the groundwater collected by the gravel drain beneath the creek bed. A new pump station downgradient from this cutoff wall would be constructed to pump water to the existing pump station for pumping to the 6930 adit. As an alternative, a series of extraction wells may be utilized to collect the contaminated groundwater downgradient from the initial cutoff wall. The water collected by the extraction wells would be pumped to an upgraded Bucktail pumpback station, then pumped to the 6930 adit. The extraction wells would be utilized only if it can be demonstrated that they are as effective at removal of metals loads as the gravel drain with downstream barrier in Bucktail Creek.

The Upper Sediment Pond on Bucktail Creek would be removed during implementation of seep collection. The Lower Sediment Pond near the mouth of Bucktail Creek would be retained to minimize the potential for Bucktail sediments to be carried into South Fork Big Deer Creek until it is determined not to be necessary.

The groundwater seep collection system will not be able to intercept all the metals in groundwater. Therefore, the predicted concentrations of metals remaining in Bucktail Creek below the groundwater seep collection system will still be elevated enough to prevent South Fork of Big Deer Creek water quality goals from being met.

Stream sediments in Bucktail Creek, South Fork of Big Deer Creek and Big Deer Creek would be cleaned up by natural recovery. The time required to achieve water quality cleanup levels in South Fork of Big Deer and Big Deer Creeks depends on the time for metals to be released from sediments through natural recovery after construction of the groundwater seepage collection system is completed. The metals release from South Fork Big Deer Creek sediments would mostly likely be complete in several years or more. Big Deer Creek sediments are expected to achieve sediment cleanup levels in several years or more. Bucktail Creek sediments at present are not releasing metals to surface water. However, after the groundwater seep collection is completed, the Bucktail Creek sediments could begin to release metals to the surface water. If this happens, the time required for Bucktail Creek sediments to naturally recover to levels that will allow meeting water quality goals in Big Deer Creek is several years or more. Following construction of the groundwater seep collection, monitoring and further evaluations will be performed to determine if further actions to achieve water quality goals are needed in the future.

9.4.3 Alternative BT-4 – Seep Collection and Treatment; South Fork Big Deer Creek Sediment Removal; Natural Recovery of Remaining Sediments

Estimated Capital Cost: $ 2.6 Million
Estimated Operations and Maintenance Cost: $ 2.4 Million
Estimated Total Present Worth Cost: $ 5 Million
Estimated Construction Time Frame: 2 to 3 years

This alternative has groundwater seep collection and treatment as well as natural recovery for Bucktail Creek and Big Deer Creek stream sediments as described under BT-3. This alternative also includes removal of in-stream sediments in South Fork Big Deer Creek for onsite disposal at the Blacktail Pit (see Figure 9-9).

By removing sediments in the South Fork of Big Deer Creek, copper and cobalt water quality cleanup levels are still not predicted to be met. The only benefit from removing the South Fork of Big Deer Creek sediments is that the sediment cleanup levels in the creek would be met for a short period of time. However, South Fork of Big Deer Creek sediments could become recontaminated from Bucktail Creek sediments. In addition, there would be short-term impacts from the disruption of riparian habitat.

9.4.4 Alternative BT-5 – Seep Collection and Treatment; Diversion of Bucktail Creek; Natural Recovery of Sediments

Estimated Capital Cost: $2.3 Million
Estimated Operations and Maintenance Cost: $ 2.4 Million
Estimated Total Present Worth Cost: $ 4.7 Million
Estimated Construction Time Frame: 2 years

This alternative has groundwater seep collection and treatment as well as natural recovery for stream sediments as described under BT-3. This alternative includes diverting Bucktail Creek in a pipeline or ditch around South Fork Big Deer Creek to discharge directly into Big Deer Creek. As described under BT-3, the groundwater seep collection will not intercept all of the groundwater and Bucktail Creek would still have elevated metals which would prevent water quality goals from being met in South Fork of Big Deer Creek. By diverting Bucktail Creek around South Fork of Big Deer in a pipeline or ditch, water quality goals in both South Fork of Big Deer and Big Deer Creeks could be met with this alternative (see Figure 9-10). Concentrations of copper in Bucktail Creek are not expected to cause water quality exceedances in Big Deer Creek after mixing.

Diverting Bucktail Creek surface water around South Fork of Big Deer Creek would decrease metals entering South Fork of Big Deer Creek to a level that water quality cleanup levels would be expected to be met in South Fork of Big Deer Creek (after natural recovery of sediments).

Since South Fork of Big Deer Creek would no longer receive metals from Bucktail Creek, the natural recovery process for the sediments should be accelerated, such that the sediment cleanup levels would likely be met sooner in South Fork of Big Deer Creek (estimated to be 2 to 5 years). The amount of time it would take for Big Deer Creek sediments to naturally recover to sediment cleanup levels could be several years or more.

9.4.5 Alternative BT-6 – Seep Collection and Treatment; Complete Sediment Removal

Estimated Capital Cost: $ 8.4 Million
Estimated Operations and Maintenance Cost: $ 2.9 Million
Estimated Present Worth Cost: $ 11.3 Million
Estimated Construction Time Frame: 3 to 5 years

This alternative has groundwater seep collection and treatment as described under BT-3. This alternative also includes removal of sediments from Bucktail, South Fork Big Deer and Big Deer Creeks to be disposed of on-site (see Figure 9-11). The groundwater seep collection will not intercept all the metals in water. Therefore, elevated levels of copper and cobalt in Bucktail Creek would prevent water quality cleanup levels from being met in South Fork of Big Deer Creek, likely for centuries. However, this alternative could result in meeting water quality cleanup levels in Big Deer Creek. Sediment cleanup levels in South Fork of Big Deer Creek and Big Deer Creek would be met through removal. However, there is the potential for recontamination of sediments since the groundwater seep collection system will not intercept all the metals in water. Complete removal of in-stream sediments would destroy existing wildlife riparian habitat, which would take years to a decade or more to re-establish. In addition, this alternative would require much more extensive construction activities and truck traffic than the other alternatives, resulting in greater risks to the community and site workers.

PANTHER CREEK DRAINAGE ALTERNATIVES

9.5 COMMON ELEMENTS FOR EACH PANTHER CREEK ALTERNATIVE

- Institutional controls (ICs) will be required for all alternatives except where contaminated materials are removed to clean up levels for unrestricted use. ICs are legal and administrative measures such as easements, restrictive covenants and enforcement tools that are used to provide notice to current and future landowners of remaining contamination on the property, to limit the use of the property, and restrict residential or other activities that could result in unacceptable exposure to remaining contamination.

- Natural recovery of Panther Creek in-stream sediments is included in all the alternatives as described under common elements for Blackbird Creek Drainage alternatives.

- Operation and maintenance of all facilities

- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of the cleanup actions

9.6 DESCRIPTION OF THE PANTHER CREEK ALTERNATIVES

The description of each alternative below includes a detailed description of distinguishing elements of the alternative that have not been described under common elements above or in a previous alternative.

Improved water quality in Panther Creek is dependent on the alternatives selected for Blackbird and Bucktail Creeks.

9.6.1 Alternative P-1 – No Further Action

Estimated Capital Cost: $0
Estimated Annual Operations and Maintenance Cost: $ 0
Estimated Present Worth Cost: $ 0
Estimated Construction Time Frame: None

Under this alternative, no action would be taken for those properties where a potential risk is shown for a future residential use. Arsenic concentrations exceed the future residential human health cleanup level in some overbank areas along Panther Creek. Currently, these areas do not pose a potential risk based on frequency of exposure to the areas. However, there is a potential for changes in future land use that could increase frequency of exposure.

9.6.2 Alternative P-2 – Institutional Controls with Natural Recovery of Panther Creek Sediments

Estimated Capital Cost: $ 0.1 Million
Estimated Operations and Maintenance Cost: $ 0.26 Million
Estimated Total Present Worth Cost: $ 0.364 Million
Estimated Construction Time Frame: 1 to 2 years to implement enforceable ICs

Under this alternative, institutional controls would be used for private property along Panther Creek where arsenic concentrations in soil exceed potential future residential cleanup levels. Institutional controls would be used at the [redacted] [redacted] former [redacted] and [redacted] (if necessary) properties where arsenic concentrations in overbank areas exceed the cleanup level. The institutional controls, such as conservation easements, would exclude residential development and use in the vicinity of the overbank deposits on these properties. The institutional controls would restrict land use, thereby reducing human exposure above acceptable risk based levels. Obtaining acceptance by private property owners and the easement grantee are necessary for this alternative. In-stream sediments are expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek (in several years or more (see Figure 9-12).

At some of the private properties where overbank soil was removed as part of the Early Actions, elevated concentrations of arsenic remain beneath the clean backfill at the water table. Institutional controls are needed to address activities that might result in exposure to the contaminated subsurface soils in the water table at the following properties: Riprap Bar 1, Riprap Bars 3 and 5, Deep Creek, Campground 2, [redacted] 2/1, [redacted] 1 (Ditch Area), [redacted] Lower Pasture ([redacted], 4/1 and 4/2), [redacted] Upstream Low Bar, [redacted]; Low Bar 1, [redacted] Low Bar 2, Noranda Pasture 3, Cobalt 1, 4, and 5, Panther Creek Inn area.

Operations and maintenance includes administration and monitoring of institutional controls for properties addressed either as Early Action or Remedial Action.

9.6.3 Alternative P-3 – Selective Overbank Deposit Removal; Natural Recovery of In-Stream Sediments

Estimated Capital Cost: $1.4 Million
Estimated Annual Operations and Maintenance Cost: $ .173
Estimated Total Present Worth Cost: $ 1.6 Million
Estimated Construction Time Frame: 1 year

Under this alternative, selected overbank deposits with arsenic concentrations in soil above the cleanup level would be removed at the [redacted] [redacted], former [redacted] and [redacted] (if necessary) properties along Panther Creek (see Figure 9-13). The removal of overbank deposits above the residential arsenic cleanup level would eliminate the potential future risks associated with those deposits and avoid the need for institutional controls, except for any remaining contaminated subsurface soils. Institutional controls will be needed at properties where contaminated subsurface soils are left at the water table. In-stream sediments are expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek (in several years or more).

This alternative includes administration and monitoring of institutional controls for properties with remaining contamination that could present a potential future risk as described above. In addition, monitoring and maintenance will be performed on selected overbank areas along Panther Creek (including near the Panther Creek Inn) following significant run-off events to ensure that these areas do not exceed human health cleanup levels due to remobilization of Blackbird Creek sediments and any overbank deposits not addressed by the remedy in this ROD.

SECTION 10

COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP requires that each remedial alternative analyzed in detail in the FS be evaluated according to specific criteria. This section evaluates the relative performance of the alternatives with respect to the nine evaluation criteria so that the relative advantages and disadvantages of each are clearly understood, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they are the threshold criteria (protection of human health and the environment and compliance with Federal or State statutes and regulations) or balancing criteria.

For a summary of the comparative analysis see Tables 10-1 to 10-3.

10.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion evaluates whether an alternative achieves and maintains adequate protection of human health and the environment.

10.1.1 Blackbird Creek Drainage

Human Health: Alternative BB-1 (the No-Further Action alternative) would not prevent direct contact with Blackbird Creek overbank deposits containing arsenic concentrations above the human health cleanup levels and therefore would not be considered protective of human health.

Alternatives BB-4 through BB-8 would all reduce direct contact with the Blackbird Creek overbank deposits through removal and/or stabilization. In addition, Alternatives BB-4 through BB-8 would reduce the potential for deposition downstream along Panther Creek at concentrations exceeding the arsenic cleanup levels. Therefore, Alternatives BB-4 through BB-8 would be protective of human health.

Environment: Alternatives BB-1, BB-4 and BB-5 are not predicted to consistently meet the copper or cobalt water quality cleanup levels in Panther Creek or the narrative cleanup goals for Blackbird Creek. Alternative BB-6 is predicted to consistently meet the copper water quality cleanup level in Panther Creek and narrative goals in Blackbird Creek. However, there is considerable uncertainty whether Alternative BB-6 could achieve the cobalt cleanup level in Panther Creek and, if it does, whether it would occur in a reasonable time period (it could take years to tens of years). Alternatives BB-7 and BB-8 are predicted to consistently meet the copper and cobalt water quality cleanup levels in Panther Creek and narrative goals in Blackbird Creek in a reasonable time period and provide the greatest degree of certainty that cleanup levels in Panther Creek will be achieved. Sediments in Blackbird Creek are expected to improve through natural recovery under all of the alternatives. Alternative BB-8 would meet cleanup narrative goals in Blackbird Creek sediments and possibly water quality more quickly but does not provide any benefit over BB-7 in achieving Panther Creek water quality cleanup levels. BB-8 would result in extensive disruption of the stream channel and habitat along Blackbird Creek that would take years to recover.

Based on the above, Alternatives BB-7 and BB-8 provide the highest degree of certainty that they would be protective of the environment in Panther Creek and meet narrative goals in Blackbird Creek.

10.1.2 Bucktail Creek Drainage

Human Health: No human health risks were shown in the Bucktail Creek Drainage.

Environment: Alternative BT-5 is the only alternative that could meet water quality and sediment cleanup levels in South Fork Big Deer and Big Deer Creeks. Alternatives BT-3, BT-4 and BT-6 could achieve water quality and sediment cleanup levels in Big Deer Creek. However, these alternatives would not achieve water quality cleanup levels in South Fork Big Deer Creek within a reasonable time frame (not likely for centuries) because of the length of time required for the metals to leach from source materials (impacted water from waste rock above the 7000 dam that will not be intercepted by seep collection). Under BT-5 sediment quality in Big Deer Creek would be expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Big Deer Creek.

10.1.3 Panther Creek Drainage

Human Health: The evaluation of overall protectiveness for the Panther Creek alternatives is focused on human health. Under current land use, overbank deposits do not pose an unacceptable risk to human health. However, if land use changes so that the frequency of exposure increases, there could be a potential risk in the future.

Alternative P-1 (No Further Action) does not provide monitoring or institutional controls of any future changes in land use. Therefore, under Alternative P-1, changes in future land use could result in unacceptable human health risks due to exposure to arsenic. Alternatives P-2 and P-3 both address potential future land use. Removal (P-3) is generally considered more reliable and permanent than monitoring and institutional controls which, if not properly enforced, could lead to human exposure to contaminants.

Alternative P-1 is not protective of human health. Alternative P-2 would be protective of human health as long as enforceable institutional controls can be implemented and properly maintained. Alternative P-3 would be protective of human health.

Environment: Water quality standards in Panther Creek will be achieved by selection of suitable alternatives for Blackbird and Bucktail Creeks. For Alternatives P-1, P-2 and P-3, sediment quality in Panther Creek would improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d) of CERCLA and 40 CFR 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate requirements (ARARs). There are a number of ARARs that the selected remedial action must attain, but the requirements of the Clean Water Act, including the NPDES requirements, are the ARARs that result in differentiation among the alternatives. As a result, the following comparative analysis regarding ARARs will focus on the ability of each alternative to protect the designated beneficial use, to attain the Idaho water quality standards for copper and to attain the NPDES discharge requirements for all pollutants (e.g., copper and cobalt). The NPDES analysis allows a mixing zone so long as it is protective of designated beneficial uses.

10.2.1 Blackbird Creek Drainage

The State of Idaho's designated beneficial use for Blackbird Creek is secondary contact recreation and the designated beneficial use for Panther Creek into which Blackbird Creek flows is cold water biota. The designation of Panther Creek for protection of cold water biota necessitates that the selected remedial actions achieve the Idaho water quality standard for copper in Panther Creek.

The Idaho water quality standard for copper for Panther Creek is not predicted to be consistently met by Alternatives BB-1, BB-4 and BB-5, especially during spring runoff. Alternatives BB-6, BB-7 and BB-8 will provide greater reductions in copper loading to Blackbird Creek and are predicted to consistently meet the Idaho water quality standard for copper in Panther Creek throughout the year.

The point source discharges from the water treatment plant, the West Fork underdrain culvert, and the other waste areas are subject to the substantive requirements of the National Pollutant Discharge Elimination System (NPDES) established by the Clean Water Act. These discharges must be limited so as to protect the designated beneficial use for Blackbird Creek of secondary contact recreation (not cold water biota) and the designated beneficial use for Panther Creek of cold water biota, as well as the cobalt risk based cleanup level for protection of cold water biota. To determine whether the discharges to Blackbird Creek are protective of the cold water biota in Panther Creek, a mixing zone analysis was performed to calculate the amount of pollutant (e.g., copper and cobalt) loading from Blackbird Creek that can mix with Panther Creek waters in a manner that is protective of cold water biota. The State of Idaho guidelines provide for a maximum mixing zone of 25%; however, this can be expanded through a site-specific mixing zone analysis. The extent to which EPA and the State determine that a larger mixing zone is protective of cold water biota affects the ability of the various alternatives to comply with the substantive requirements of the Clean Water Act.

The remaining sources for copper and cobalt along Blackbird Creek are different. There are several different copper sources, while the primary source for cobalt loading is the West Fork Tailings Impoundment. This means that copper and cobalt behave differently in terms of the mixing zones in Panther Creek. The mixing zone analysis performed in the FS revealed that the amount of contaminated overbank deposits left in place along Blackbird Creek affects the amount of the post-remediation copper loads and, therefore, the size of the mixing zone for copper. The mixing zone analysis showed that Alternatives BB-6, BB-7 and BB-8 would result in a smaller mixing zone for copper than Alternatives BB-4 and BB-5 because these alternatives remove more overbank deposits along Blackbird Creek than Alternatives BB-4 and BB-5. A mixing zone analysis was also conducted for cobalt in Panther Creek. This analysis indicated that Alternatives BB-5, BB-7 and BB-8 would generally result in smaller mixing zones than Alternatives BB-4 and BB-6 because these alternatives rely upon treatment of groundwater at the West Fork Tailings Impoundment, which provides greater and more reliable cobalt reduction. A smaller mixing zone is preferred.

The mixing zone analysis for copper utilized data from the spring and fall synoptic sampling events. For Alternatives BB-4 and BB-5, the mixing zone analysis indicated that, under worst case conditions, the copper water quality standard would not be met even with 100% mixing in the spring. In the fall, a mixing zone requiring approximately 53% of the width of Panther Creek would be required. For Alternatives BB-4 and BB-5 under average case conditions, the mixing zone requirement for copper would vary from approximately 48% of the width of Panther Creek in the spring to approximately 30% of the width of Panther Creek in the fall. For Alternatives BB-6, BB-7 and BB-8, the analysis indicated that, under worst case conditions, a mixing zone for copper of 62% of the width of Panther Creek would be required in the spring. In the fall a mixing zone requiring approximately 50% of the width of Panther Creek would be required. For Alternatives BB-6, BB-7 and BB-8, under average case conditions, the mixing zone requirement for copper would be approximately 30% of the width of Panther Creek in the spring and in the fall. It should be noted that, due to physical constraints in Panther Creek in the vicinity of the Blackbird Creek confluence, the minimum mixing zone that could be achieved (regardless of alternative) under worst case is 50% of the width of Panther Creek. Under average conditions, the minimum width of the mixing zone is 30%.

The worst and average cases are included in the copper mixing zone analysis to provide both the maximum and average mixing zone conditions in Panther Creek. By definition, the worst case scenario flows would occur less than 5% of the time. In addition, in natural streams the highest copper concentrations do not occur during the lowest flows, as modeled in the worst case scenario. The combination of these two unlikely events implies that the worst case scenario would occur much less than 5% of the time. The average case is more representative of the system because it matches average copper concentrations with average flows. Therefore, the comparative analysis is based on the average case.

A mixing zone analysis for cobalt, utilizing the synoptic sampling data, would not provide meaningful results. This is because cobalt behaves differently than copper in the Blackbird and Panther Creek systems. Copper concentrations tend to be at a maximum during the spring runoff and at a minimum during low flow periods. Cobalt concentrations tend to be at a maximum during low flow periods (fall, winter, and early spring) and at a minimum during late spring and summer periods when flows are higher in Panther Creek. Thus, an analysis of the potential mixing zones required in Panther Creek for cobalt must use a different data set than the synoptic spring and fall sampling. A mixing zone analysis was developed using monthly cobalt data that were collected from December 2001 through November 2002. These data are shown in Table 5-9. This analysis utilized these data and average cobalt reductions for each of the alternatives presented in the FS to predict the mixing zones that would be required in Panther Creek to meet the cobalt cleanup level of 38 μg/L. This analysis indicated the following:

- Alternative BB-4 would have required mixing zones of about 30 to 55 percent during late spring through summer (the minimum mixing zone is 30 percent due to hydraulic conditions in Panther Creek). The required mixing zones would range from about 55 to 100 percent during the rest of the year. The cobalt cleanup level would be exceeded, even with 100 percent mixing, during significant portions of the year.

- Alternative BB-5 would require mixing zones of about 30 to 45 percent during late spring through summer. The required mixing zones would range from about 45 to 85 percent during the rest of the year.

- Alternative BB-6 would require mixing zones of about 30 to 40 percent during late spring through summer. The required mixing zones would range from about 40 to 100 percent during the rest of the year.

- Alternative BB-7 would require mixing zones of about 30 percent (the minimum mixing zone) during late spring through summer. The required mixing zones would range from about 30 to 70 percent during the rest of the year.

- Alternative BB-8 would require mixing zones of about 30 percent (the minimum mixing zone) during late spring through summer. The required mixing zones would range from about 30 to 65 percent during the rest of the year.

A statistical analysis of stream flows and hydraulic modeling was not conducted for the cobalt mixing zone analysis. Thus, the mixing zones noted for each of the alternatives are more likely to represent average case conditions than worst case conditions.

The cobalt data collected during March 2001 and 2002 indicated that there were anomalously high cobalt concentrations in Panther Creek for about a three to four week period. These anomalously high concentrations could have been due to several possibilities. These include:

- Rapid melting of frozen springs and seeps at the West Fork Impoundment. Surface discharges at these springs and seeps could have frozen during the course of the winter and built up ice deposits high in cobalt. When these ice deposits thawed in March, they could have discharged a slug of cobalt to the surface water system.

- Discharges of high concentrations of cobalt from overbank deposits along Blackbird Creek. Snowmelt and rainfall during March could have infiltrated through the overbank deposits, resulting in higher than normal cobalt loads being discharged to Blackbird Creek.

- Unusually high groundwater flows and/or cobalt concentrations from the West Fork Tailings Impoundment. A mechanism that would cause unusually high flows or concentrations has not been identified.

Additional monitoring will be conducted to determine if the anomalously high cobalt concentrations are a recurring phenomenon. If so, additional investigations will be conducted to determine the source of these cobalt loadings. If the anomalously high cobalt concentrations are a recurring phenomenon, the alternatives that include treatment at the West Fork Impoundment (Alternatives BB-5, BB-7 and BB-8) would be more likely to be able to address the situation. This is because the collection and treatment systems could be designed to intercept the increased cobalt loads, unless the loads are coming from the overbank deposits. If the increased cobalt loads are coming from the overbank deposits, then the alternatives that include overbank deposit removal (Alternatives BB-6, BB-7 and BB-8) would be more likely to address the increased loads.

Under average case conditions, Alternatives BB-7 and BB-8 are more likely than Alternatives BB-4, BB-5 and BB-6 to attain a mixing zone for both copper and cobalt that could be protective of cold water biota. The selected response action will be monitored to determine if the mixing zone is protective of cold water biota or if contingent actions will be needed to comply with the NPDES requirements.

Chemical discharge limits have not been set for the existing water treatment plant and for the West Fork underdrain culvert. The discharge limits cannot be set at the present time because the discharge limits must be set for total recoverable metals concentrations. Virtually all of the existing data for discharges from the existing water treatment plant are in terms of total recoverable metals. However, all of the loading analyses and the mixing zone analyses have been conducted using dissolved metals. This means that a metals translator must be used to calculate the dissolved/total recoverable metals ratios and to set the discharge limits. Since the data do not currently exist to develop statistically valid site-specific dissolved/total recoverable metals ratios, these data must be collected. These data will be collected and the discharge limits will be set once the data are available.

Other ARARs would be met by all action alternatives.

10.2.2 Bucktail Creek Drainage

The No-Further Action alternative (BT-1) would not meet the Idaho water quality standard for copper in either South Fork Big Deer or Big Deer Creeks. Alternatives BT-3, BT-4 and BT-6 would meet Idaho water quality standards for copper in Big Deer Creek, but not in South Fork Big Deer Creek. Alternative BT-5 is the only alternative that can meet ARARs in Big Deer Creek and South Fork Big Deer Creek in a reasonable time frame. However, it is possible that groundwater discharges into South Fork Big Deer Creek could prevent consistently meeting water quality goals even with the Bucktail Creek diversion. If this is the case, contingencies to address the groundwater discharges would be evaluated for the South Fork Big Deer Creek.

The discharge of the diverted Bucktail Creek into Big Deer Creek must be limited so as to protect the designated beneficial use for Big Deer Creek of cold water biota. The NPDES requirements and the mixing zone provisions of the Clean Water Act and the State of Idaho Water Quality Standards are relevant and appropriate for analyzing the effect of this discharge. To determine whether this discharge is protective of cold water biota in Big Deer Creek, a mixing zone analysis was performed to calculate the amount of copper loading from Bucktail Creek that can mix with Big Deer Creek in a manner that is protective of cold water biota. A mixing zone analysis for cobalt is not necessary because cobalt in Big Deer Creek is significantly below the water quality cleanup level of 38 μg/L under existing conditions.

The mixing zone analysis for copper indicated that all of the action alternatives (BT-3 through BT-6) would be essentially comparable in terms of mixing zone requirements in Big Deer Creek. Because of physical constraints in Big Deer Creek near its confluence with the South Fork, there would be no essential difference between Alternative BT-5 and the other alternatives in terms of the mixing zone in Big Deer Creek. The analysis indicated that, under worst case conditions, the copper water quality standard would not be met in Big Deer Creek for any of the action alternatives, even with 100% mixing in both the spring and fall. Under average case conditions, the entire width (100%) of Big Deer Creek would be required for mixing. However, the copper water quality predictions were based on the conservative assumption that 65% of the copper loads discharging to Bucktail Creek would be collected and treated. If 80% copper load removal is assumed, the mixing zone requirement for all of the action alternatives would be 100% of the width of Big Deer Creek under worst case conditions in the spring and 91% of the width of Big Deer Creek in the fall. Under the average case conditions, 70% of the width of Big Deer Creek would be required for mixing in both spring and fall. It should be noted that 70% of the width of Big Deer Creek is the minimum mixing zone that could be achieved, regardless of alternative and upstream copper load reductions. This is due to physical constraints in the vicinity of the confluence of South Fork and Big Deer Creeks.

The worst and average cases are included in the mixing zone analysis to provide both the maximum and average mixing zone conditions in Big Deer Creek. By definition, the worst-case scenario flows would occur less than 5% of the time. In addition, in natural streams the highest copper concentrations do not occur during the lowest flows, as modeled in the worst-case scenario. The combination of these two unlikely events implies that the worst-case scenario would occur much less than 5% of the time. The average case is more representative of the system because it matches average copper concentrations with average flows. Therefore, the comparative analysis is based on the average case.

Other ARARs would be met by all alternatives.

10.2.3 Panther Creek Drainage

All of the alternatives for Panther Creek would comply with ARARs.

10.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion evaluated the ability of an alternative to maintain protection of human health and the environment over time. The following factors were considered in the evaluation of long-term effectiveness:

- Magnitude of the residual risks remaining at the completion of remedial activities.

- Adequacy and long-term reliability of management and technical controls for providing continued protection from the residual risks.

10.3.1 Blackbird Creek Drainage

Human Health: All the alternatives except BB-1 would prevent direct contact with contaminated soils above cleanup levels and minimize remobilization of contaminated soils downstream. Removal of most of the overbank deposits (Alternatives BB-6, BB-7 and BB-8) would provide greater reliability and permanence than physical stabilization in Alternatives BB-4 and BB-5.

Environment: Alternative BB-1 (No Further Action) would not make any improvements to water quality, and does not provide for long-term effectiveness. Alternatives BB-4 and BB-5 are rated lower than other alternatives for long term effectiveness. These alternatives leave more contaminated material in place by primarily utilizing stabilization to address Blackbird Creek overbank deposits. The contaminated soils left in place leach copper and cobalt to surface water which results in these alternatives being less likely to meet the copper water quality cleanup level during spring runoff. Alternatives BB-6, BB-7 and BB-8, that primarily utilize removal to address Blackbird Creek overbank deposits, provide the highest degree of effectiveness because they have greater certainty of achieving the copper water quality cleanup level in Panther Creek on a consistent basis. Alternatives BB-6, BB-7 and BB-8 are essentially comparable in terms of copper water quality predictions in Panther Creek; but predicted cobalt concentrations vary among these alternatives.

Alternative BB-1 is rated lowest for long-term effectiveness at reducing cobalt concentrations in Panther Creek. Alternatives BB-4 and BB-6, that rely upon the West Fork Tailings Impoundment cover, are not predicted to be effective at consistently meeting the cobalt cleanup level in Panther Creek during the periods of highest cobalt concentrations (fall, winter, and early spring). Alternatives BB-5, BB-7 and BB-8, that rely upon treatment at the Tailings Impoundment, are predicted to have greater certainty of achieving the cobalt cleanup level in Panther Creek. However, during the periods of highest cobalt concentrations, Alternative BB-5 may not consistently achieve the cobalt cleanup level because more overbank deposits are left in place and stabilized.

Alternatives BB-7 and BB-8 provide the highest degree of effectiveness because they are the only alternatives that are predicted to consistently achieve the copper and cobalt cleanup level in Panther Creek. However, the extensive sediment removals under Alternative BB-8 would provide no discernable benefit to cobalt water quality in Panther Creek. Sediments in Blackbird Creek are expected to improve through natural recovery under all of the alternatives.

Alternative BB-4 has the highest residual risks because it would utilize the cover to address cobalt releases from the West Fork Tailings Impoundment and primarily stabilization through armoring to address overbank deposit risks. Alternative BB-6 has the next highest residual risk because it utilizes only the cover at the impoundment which is judged less reliable to address cobalt releases. BB-5 has less residual risk than BB-6 because it includes treatment for the cobalt releases at the impoundment. However, Alternative BB-5 would utilize primarily armoring for Blackbird Creek overbank deposits which would leave considerable contaminated material in place. Alternative BB-7 has a lower residual risk since it utilizes treatment to address the cobalt releases and would address the overbank deposit risks primarily through removal. Alternative BB-8 has the least residual risk because it primarily utilizes treatment to address the cobalt releases (which has greater certainty of effectiveness) and would eliminate the overbank deposit risks through complete removal.

All of the alternatives are judged to be comparable in terms of permanence. All of the alternatives depend on proper operation and maintenance of the facilities, ICs and monitoring. As long as the operation and maintenance is properly performed in the future, all of the facilities are considered permanent. However, alternatives BB-6, BB-7 and BB-8 are considered more permanent than other alternatives in addressing the overbank deposits because they utilize primarily removal. Alternative BB-8 is considered the most permanent in addressing overbank deposits but provides no additional environmental benefit for achieving water quality cleanup levels.

10.3.2 Bucktail Creek Drainage

Alternative BT-5 is judged to have the best long-term effectiveness because it is predicted to meet the copper and cobalt water quality and sediment cleanup levels in South Fork of Big Deer and Big Deer Creeks in a reasonable time frame.

All of the other action alternatives (BT-3, BT-4, and BT-6) would be essentially equivalent in terms of long-term effectiveness. They would all achieve water quality cleanup levels in Big Deer Creek; however, South Fork of Big Deer Creek water quality cleanup levels would not be met for centuries. The primary difference among Alternatives BT-3, BT-4 and BT-6 is the time to achieve sediment cleanup levels. Alternatives BT-4 and BT-6 would meet sediment cleanup levels in South Fork Big Deer Creek upon completion of remedial actions. Alternative BT-6 would meet sediment cleanup levels in both South Fork of Big Deer and Big Deer Creeks upon completion of remedial actions. However, since not all the groundwater will be intercepted by the seep collection system, there is the potential for re-contamination of sediments from Bucktail Creek water and sediments. Alternative BT-3 would require years to a decade or more to achieve sediment cleanup levels in South Fork of Big Deer Creek and Big Deer Creek. Alternative BT-5 would require a few years to achieve sediment cleanup levels in South Fork Big Deer Creek and years to a decade or more to achieve sediment cleanup levels in Big Deer Creek. Under BT-5, sediment quality in Big Deer Creek would be expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Big Deer Creek. Meeting sediment cleanup levels in Big Deer Creek is not as time critical for improvement of aquatic habitat as meeting surface water cleanup levels. Benthic communities in Big Deer Creek should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve with improving water quality in Big Deer Creek until sediment cleanup levels are achieved. Therefore, the time to achieve sediment cleanup levels is not expected to affect the long-term effectiveness. The sediment removals in BT-4 and BT-6 would reduce the time to achieve sediment cleanup levels in South Fork of Big Deer Creek; however, there would be the potential for recontamination of the sediments and the removal would cause considerable short-term disruption of the stream channels and riparian habitat with no environmental gain to water quality.

Alternative BT-6 has the lowest level of residual risks because all the sediments would be removed. This would eliminate the potential for metals to leach from the sediments and remobilize and deposit downstream during large storm events. All of the action alternatives (BT-3, BT-4, BT-5 and BT-6) would be essentially equivalent in terms of reliability of controls and permanence. As long as the operation and maintenance of these facilities is properly performed, any of the Bucktail Creek action alternatives would provide a permanent remedy.

10.3.3 Panther Creek Drainage

Alternatives P-2 and P-3 both address potential future land use. Removal (P-3) is generally considered more reliable and permanent than institutional controls which, if not properly followed and enforced, could lead to unacceptable human health risks due to exposure to contaminants.

For Alternatives P-1, P-2 and P-3, sediment quality in Panther Creek would improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek. Meeting sediment cleanup levels in Panther Creek is not as time critical for improvement of aquatic habitat quality as is meeting the surface water cleanup levels in Panther Creek. The reason is that most of the current measured sediment concentrations are below known probable toxic levels; thus, benthic communities in Panther Creek should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve with improving water quality in Panther Creek despite the current exceedances of the sediment cleanup levels. Therefore, the time to achieve sediment cleanup levels is not expected to affect the long-term effectiveness.

10.4 REDUCTION OF TOXICITY, MOBILITY AND VOLUME THROUGH TREATMENT

CERCLA states a preference for selecting remedial actions that principally employ treatment technologies to permanently and significantly reduce toxicity, mobility or volume of the hazardous substances at the site. See Section 11 for a discussion of principal threat waste at the site.

10.4.1 Blackbird Creek Drainage

All of the alternatives include treatment of contaminated water at the existing Water Treatment Plant. Alternative BB-1 involves continued operation of the existing WTP at existing flow rates. Alternatives BB-4 and BB-6 add treatment of additional seepage to be collected from Meadow Creek. Alternatives BB-5, BB-7 and BB-8 provide treatment of both Meadow Creek seepage and Tailings Impoundment seepage.

10.4.2 Bucktail Creek Drainage

Alternative BT-1 would provide treatment of only waters intercepted as part of the Early Actions. Alternatives BT-3, BT-4, BT-5 and BT-6 would provide the same reduction in toxicity, mobility and volume through treatment of the collected Bucktail Creek groundwater.

10.4.3 Panther Creek Drainage

Since none of the Panther Creek alternatives involve treatment, there is no difference among these alternatives for this criterion.

10.5 SHORT-TERM EFFECTIVENESS

The short-term impacts of alternatives were assessed by considering the following: (1) short-term risks that might be posed to the community during implementation of an alternative; (2) potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; (3) potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and (4) time until protection is achieved.

10.5.1 Blackbird Creek Drainage

Alternative BB-1 is rated highest for short-term effectiveness because it would not result in risks to workers or the community and would have no short-term environmental impacts associated with remedial actions. Alternatives BB-4, BB-5, BB-6 and BB-7 are essentially comparable in terms of risks to the community and workers during construction and short-term environmental risks. Each of these four alternatives could be completed within 1 to 2 years. Alternatives BB-5 and BB-7, that involve treatment to address cobalt, would improve water quality much more rapidly than Alternatives BB-4 and BB-6 that rely upon covering the impoundment for cobalt reductions. Alternative BB-8 is rated lowest for short-term effectiveness. This alternative would extensively disturb the stream channel and vegetation requiring a decade or more to re-establish growth. The removal and construction activities would create more short-term risk to the community, site workers and the environment than the other alternatives.

10.5.2 Bucktail Creek Drainage

Alternative BT-1 is rated highest for short-term effectiveness since there would be no short-term impacts to the environment, workers or the community. Alternatives BT-3 and BT-5 are rated next highest for short-term effectiveness and BT-3 has a slight edge because it involves less construction.

Both alternatives would have minimal risks to the community, acceptable construction risks, minimal unavoidable short-term environmental risks, and could be implemented within 2 years. Alternative BT-4 is rated lower than Alternatives BT-3 and BT-5 because the sediment removal in South Fork Big Deer Creek would result in greater construction risks and considerable disruption of the stream channel and riparian habitat. Alternative BT-6 is rated lowest because the extensive sediment removal could result in greater construction risks, and extensive disruption of stream channels and riparian habitat, and a much longer construction period.

10.5.3 Panther Creek Drainage

Alternative P-3 may take longer to implement than Alternative P-2, depending on the time to implement enforceable institutional controls. Removal would create short-term risks to the community and site workers due to truck traffic and excavation equipment, and short-term disruption of ecological habitat. Alternative P-3 would require 1 to 2 years to implement.

10.6 IMPLEMENTABILITY

The implementability of the alternatives was assessed by considering, as appropriate, the following factors: (1) technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy; (2) administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions); and (3) availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.

10.6.1 Blackbird Creek Drainage

Alternative BB-1 is rated highest for technical implementability since no further actions would be required. Alternative BB-6 is rated next highest for technical implementability, since this alternative would not involve design and construction of collection and treatment facilities. Alternative BB-4 is rated next highest because there may be difficulties locating sufficiently sized armoring materials. Alternative BB-7 is rated next highest for technical implementability because this alternative includes collecting and treating. Alternative BB-5 is rated lowest because this alternative includes armoring plus collecting and treating.

10.6.2 Bucktail Creek Drainage

Alternatives BT-3 and BT-5 are essentially comparable since both alternatives would utilize standard construction techniques. Alternative BT-4 is rated lower due to the need for stream diversion, dewatering and sediment control during the sediment removal. Alternative BT-6 is rated lowest because of the need for stream diversion, dewatering and sediment control during the sediment removal, the need to site, design and maintain an on-site repository, and the uncertainty of approval for construction of an access road along Big Deer Creek. All of the alternatives are rated comparable in terms of implementing institutional controls on lands administered by the Forest Service.

10.6.3 Panther Creek Drainage

Alternative P-2 requires a long-term monitoring program and institutional controls. Administratively, this alternative would be the most difficult to implement of the Panther Creek Alternatives because it depends upon the acceptance of land use restrictions by the property owners, and acceptance by an independent third party as grantee of the land restriction easements. Alternative P-3 would be more difficult to physically implement than Alternative P-2 because of the effort involved in removing overbank deposits.

10.7 COST

This criterion includes estimated capital and operation and maintenance costs as well as present worth costs. Cost estimates are expected to be accurate within a range of +50 to -30 percent. Table 10-4 presents a comparative summary of the total capital costs, the present worth of O&M cost, and the total present worth costs for all the alternatives including the discount rate and the number of years used in the estimate.

10.7.1 Blackbird Creek Drainage

Alternative BB-7 is the least costly of the alternatives that are protective of human health and the environment by meeting both the copper and cobalt water quality cleanup levels in Panther Creek with certainty and in a reasonable time period. Alternatives BB-4 through BB-6 are less costly than BB-7; however, they are not predicted to meet water quality cleanup levels with as much certainty and in a reasonable time period. Alternative BB-8 would not provide any substantial improvements to water quality in Panther Creek compared to Alternative BB-7. Therefore, the substantial difference in costs associated with Alternative BB-8 would not be justified, especially considering the extensive short-term environmental impacts and difficulty in implementing this alternative.

10.7.2 Bucktail Creek Drainage

Alternative BT-3 is the least costly; however, this alternative will not achieve sediment cleanup levels and would not meet the Idaho water quality standard for copper in South Fork of Big Deer in a reasonable time frame. Alternative BT-5 costs approximately $300,000 more than BT-3 and would meet water quality cleanup levels and ARARs in both South Fork Big Deer Creek and Big Deer Creek. The other action alternatives (BT-4 and BT-6) would be considerably more costly.

10.7.3 Panther Creek Drainage

The estimated cost for Alternative P-2 is lower than for Alternative P-3, although there is some uncertainty in the costs of implementing and monitoring institutional controls.

10.8 STATE ACCEPTANCE

The State of Idaho has been involved in the development of the Remedial Investigation and Feasibility Study that supports the ROD. The State's concurrence letter which supports the remedy selected in the ROD is provided in Appendix C.

10.9 COMMUNITY ACCEPTANCE

This criterion evaluates whether the local community agrees with EPA's analyses and preferred alternative that was put out for public comment in the Proposed Plan.

EPA has carefully considered all comments submitted during the public comment period and taken them into account during the selection of the remedy for the Blackbird Mine site. EPA's responses to comments received during the public comment period are included in the attached Responsiveness Summary (Appendix D). Some of the comments support EPA's preferred alternative put out for public comment and some of the comments do not support EPA's preferred alternative.

SECTION 11

PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practical. A principal threat concept is applied to the characterization of "source material" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contaminants to groundwater, surface water or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. In determining an appropriate range of alternatives for sites with high volume/low risk waste, EPA has stated its position in the NCP as well as guidance documents. Specifically, EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable [40 CFR 300.430(a)(iii)(B)]. In addition, EPA Guidance for Conducting RI/FS under CERCLA, Interim Final (EPA, 1988) states "Development of a complete range of treatment alternatives will not be practical in some situations. For example, for sites with large volumes of low concentrated wastes such as some municipal landfills and mining sites, an alternative that eliminates the need for long-term management may not be reasonable given site conditions, the limitations of technologies, and extreme costs that may be involved."

Mining activity within the Blackbird Mine resulted in about 14 miles of underground workings, a 12-acre open pit, 4.8 million tons of waste rock in numerous piles, and two million tons of tailings disposed of at a tailings impoundment. The waste rock and tailings contain high concentrations of metals that are released to the environment through acid rock drainage or erosion. These source materials could be considered a principle threat waste as defined above.

Treatment technologies for the source materials (waste rock and tailings) were considered in the screening of technologies in the Analysis of Alternatives reports for the Early Actions and in the FS. The treatment technologies that were considered were biological, thermal and chemical fixation. The technologies were screened out and not carried forward in the detailed analysis of alternatives because they were deemed to be not effective or have poor effectiveness and be less implementable and significantly more costly than other options.

The selected alternative in this ROD does utilize treatment of contaminated surface water and groundwater that has been impacted by metals leaching from source materials.

SECTION 12

THE SELECTED REMEDY

The selected remedy is BB-7 for the Blackbird Creek Drainage, BT-5 for the Bucktail Creek Drainage and a combination of P-2 and P-3 for the Panther Creek Drainage. These remedies are discussed more fully below. The selected remedy meets the requirements of the two mandatory threshold criteria: protection of human health and the environment, and compliance with ARARs, while providing the best balance of benefits and tradeoffs among the five balancing criteria: long-term effectiveness; short-term effectiveness; implementability; reduction in toxicity, mobility and volume through treatment; and cost. The selected remedy also provides for meeting the remedial action objectives and remediation goals presented in Section 8.

12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

The key factors upon which the remedy decision is based are presented below along with a description of how the selected remedy meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria.

12.1.1 Blackbird Creek Drainage Area

The selected remedy for the Blackbird Creek drainage area is BB-7 which is comprised of the following:

- Collection of Meadow Creek seeps
- Covering the West Fork Tailings Impoundment and treating tailings impoundment seepage
- Removal with selective stabilization of overbank deposits along Blackbird Creek
- Natural recovery of in-stream sediments in Blackbird Creek
- Institutional controls
- Operations, maintenance and monitoring
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

The selected remedy is expected to be protective of human health and the environment and is expected to meet all ARARs. The selected remedy is expected to have a smaller mixing zone for both copper and cobalt in Panther Creek to meet the NPDES substantive requirements than other alternatives that rely on primarily stabilizing overbank deposits and only covering the West Fork Tailings Impoundment.

The selected remedy incorporates the Early Actions, including the collection and treatment of Meadow Creek seeps which will reduce the amount of copper being released from waste rock.

The selected remedy utilizes covering the West Fork Tailings Impoundment and treating groundwater seeping from the impoundment. Treatment has the greatest degree of certainty and is the most effective means of achieving cobalt water quality cleanup levels in Panther Creek during all times of the year. There is uncertainty whether alternatives that rely on only the cover at the West Fork Tailings Impoundment will ever achieve cobalt water quality cleanup levels and if so how long it would take (could take years to tens of years). With treatment of groundwater at the West Fork Tailings Impoundment, the cobalt water quality cleanup level should be achieved within 1 to 2 years following completion of construction.

The selected remedy will reduce human health risks from direct contact to arsenic in the Blackbird Creek overbank deposits (soils and tailings) by removing large volumes of deposits and stabilizing in place only a limited amount of areas. Removal of large volumes of overbank deposits will provide greater reliability and permanence than alternatives that primarily stabilize the material in place. Removal of the overbank deposits also will be more reliable at reducing the potential for remobilization of arsenic contaminated soil/tailings during large runoff events and depositing the material downstream on the banks of Panther Creek. In addition, removal of large volumes of overbank deposits will contribute to meeting copper and cobalt water quality cleanup levels because the contaminated materials will not be present to leach copper and cobalt to surface water. Alternatives that rely on primarily stabilizing the overbank deposits are not predicted to achieve the copper water quality goal in Panther Creek during all times of the year.

Residual risk is low for the selected remedy because it utilizes treatment to address copper and cobalt releases to surface water and, primarily, removal to address risks from overbank deposits to humans.

The selected remedy can be implemented using standard construction techniques. Designing, installing, and operating the collection and treatment system for Tailings Impoundment seepage would be more difficult than alternatives that do not include treatment. However, the difficulties are outweighed by the significant environmental benefits.

12.1.2 Bucktail Creek Drainage Area

The selected remedy for the Bucktail Creek Drainage area is BT-5 and is comprised of the following elements:

- Groundwater seep collection and treatment
- Diversion of Bucktail Creek
- Natural recovery of sediments
- Institutional controls

- Operations, maintenance and monitoring
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

Phase 1 of the seep collection system is being performed as a modification to the Early Action. Phase II of the groundwater interception will be implemented as part of the selected remedial action, unless EPA determines that Phase II is not necessary. No unacceptable human health risks were shown in the Bucktail Creek drainage.

The selected remedy is expected to be protective of the environment. This alternative is expected to meet the copper and cobalt cleanup levels in Big Deer Creek and South Fork of Big Deer Creek. Other alternatives do not include the diversion pipeline around South Fork of Big Deer Creek and, therefore, will not meet the copper and cobalt cleanup levels in South Fork of Big Deer Creek. A mixing zone analysis was performed for Big Deer Creek in accordance with the NPDES requirements and all the alternatives have similar mixing zones for copper.

Bucktail Creek flows in excess of the capacity of the diversion pipeline (10-year storm event) would overflow into South Fork Big Deer Creek. However, this overflow is expected to occur during times of increased flow in South Fork Big Deer Creek as well as Bucktail Creek. The increased flows would provide additional dilution in both creeks, such that the effects of overflow on water quality and sediments would be expected to be minimized and of short duration.

The construction of the diversion pipeline would mean that the sediments in South Fork Big Deer Creek would no longer be consistently subjected to the metals in the Bucktail Creek flows. This should speed the natural recovery process for the sediments, such that the sediment cleanup levels would be met in South Fork Big Deer Creek more rapidly than other alternatives that do not include the pipeline.

Sediment quality in Big Deer Creek would be expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Big Deer Creek. Meeting sediment cleanup levels in Big Deer Creek is not as time critical for improvement of aquatic habitat quality as meeting surface water cleanup levels. Benthic communities in Big Deer Creek should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve with improving water quality in Big Deer Creek despite the current exceedances of the sediment cleanup levels.

12.1.3 Panther Creek Drainage Area

The selected remedy is a combination of Alternatives P-2 and P-3. The contaminated areas at the R(b)(6) and former St(b)(6) properties are relatively small. Therefore, soil in overbank deposits will be removed at the [redacted] and former [redacted] properties to the human health cleanup level for arsenic. The contaminated overbank deposits at the [redacted] property are large areas. These areas will have ICs if acceptance of the property owner can be obtained. If acceptance of the property owner cannot be obtained, then the overbank deposits will be removed to the human health cleanup level. In addition to Institutional Controls, operations, maintenance and monitoring are also elements of this selected remedy. Five year reviews will also be conducted to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions.

Institutional controls will also be needed at some of the private properties where overbank deposits have been removed as an Early Action to preclude unacceptable future exposure if underlying soils with elevated arsenic concentrations are brought to the surface (as a result of erosion, digging or construction activities). The Early Action properties that will require ICs for underlying soils are: Riprap Bar 1, Riprap Bars 3 and 5, Deep Creek, Campground 2, [redacted] 2/1, [redacted] 1 (Ditch Area), [redacted] Lower Pasture [redacted] 4/1 and 4/2), [redacted] Upstream Low Bar, [redacted] Low Bar 1, [redacted] Low Bar 2, Noranda Pasture 3, Cobalt 1, 4, and 5, and the Panther Creek Inn area.

Human health would be protected by preventing human exposure to arsenic concentrations above the human health cleanup level for future residential use via selective removal of overbank deposits and/or institutional controls. There were no unacceptable environmental risks associated with the overbank soils. Water quality in Panther Creek is dependent on the alternatives selected for Blackbird and Bucktail Creeks. Sediments are expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek.

This alternative would meet all ARARs.

The selected remedy provides for a reliable and permanent remedy with removal of all soils above the residential arsenic cleanup level at some of the properties, such that, if land uses change to residential in the future, this alternative would prevent potential human health risks. Monitoring would be conducted following significant runoff events that might mobilize sediments from Blackbird Creek.

If acceptable to the property owner at the [redacted] property, ICs with proprietary controls, such as conservation easements that would exclude residential development in the vicinity of the overbank deposits, would be implemented. The proprietary controls would be layered with informational devices implemented by EPA. The grantee of the easements would be an independent third party, preferably a government entity. Institutional controls are effective and reliable if they are maintained and enforced.

Removal would take no more than one construction season, except at the [redacted] property, where removal could take more than one season.

This alternative is feasible both technically and administratively. This alternative could be implemented using standard construction techniques. For properties with ICs, obtaining acceptance by property owners and the Grantee are the primary implementation difficulties associated with this alternative. The willingness of the private property owners to grant the easements is uncertain. In addition, an independent third party that is willing to accept the grants of easement has not been identified.

DESCRIPTION OF THE SELECTED REMEDY

12.2 BLACKBIRD CREEK DRAINAGE BASIN

The cleanup levels for the selected remedy described below are provided in Section 8.

The remedial actions in the Blackbird Creek basin are shown in Figure 9-5 and will include the following:

- Collection and treatment of upper Meadow Creek seeps
- Continued operation of the water treatment plant
- Construction of a soil cover over the West Fork Tailings Impoundment
- Collection and treatment of seepage from the West Fork Tailings Impoundment
- Removal of overbank deposits with armoring of selected deposits
- Removal of in-stream sediments and overbank deposits in the vicinity of the PCI
- Establishing institutional controls and physical restrictions
- Natural recovery of Blackbird Creek sediments
- Operations and maintenance of Early Actions and remedial actions
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

12.2.1 Collection and Treatment of Upper Meadow Creek Seeps

In the upper reaches of Meadow Creek, a number of seeps have been observed between the toe of the 7800 waste rock dump and the 7350 detention basin. Water chemistry analyses have shown metals loading in this area that contributes to elevated concentrations observed in Blackbird and Panther Creeks during spring runoff. A seep collection system was constructed in this area during the Early Actions; however, the data indicate that additional actions are required in this area to achieve water quality cleanup levels. The further actions are being performed as a modification to the Early Actions. The further actions will involve revising the drainage systems below the 7800 waste rock dump to collect contaminated water via the Meadow Creek channel. The intent is to separate clean water in the upper creek from lower creek water affected by seepage containing elevated metals. Currently, this portion of upper Meadow Creek discharges into the existing 7350 detention basin, and is then routed to the 7100 West Clean Water Pipeline. The existing 7350 diversion structure will be modified so that Meadow Creek will discharge into the 7100 reservoir for treatment in the Water Treatment Plant. This will provide collection for storage and treatment of seeps containing high levels of metals from the area below the toe of the 7800 waste rock dump and debris flow deposits. Clean water from the upper creek will be intercepted by a clean water diversion ditch and piped to the existing 7100 West Clean Water Pipeline.

12.2.2 Continued Operation of the Water Treatment Plant

The continued operation of the existing Water Treatment Plant (WTP) will be necessary for treatment of waters collected by the Early Actions and for treatment of additional contaminated waters collected as part of the Remedial Actions. The WTP is a lime precipitation plant that currently treats water from the 7100 dam, the underdrain flows below the Meadow Creek cover, and the 6850 Portal (mine waters and Bucktail Creek waters transported through the mine). The WTP is located in the upper part of Blackbird Creek near the location of the previous mill and office buildings, approximately 7 miles upstream from the confluence of Blackbird Creek and Panther Creek. The WTP currently treats a yearly average of about 300 gallons per minute (gpm) with a maximum monthly average of about 650 gpm. The design capacity is 800 gpm with maximum hydraulic capacity of 1,000 gpm.

Under CERCLA, a National Pollutant Discharge Elimination System (NPDES) permit is not required for on-site actions that are necessary for implementation of the response action where the discharge receiving water is in the area of contamination or other areas that are in close proximity. Current discharges from the WTP are regulated under an NPDES permit, #ID-002525-9, which expired on October 30, 1989. A new permit application was submitted to EPA; however, EPA deferred action on the new permit application until completion of the RI/FS and ROD process. The NPDES permit will not be renewed for treatment of water covered under these CERCLA actions. Instead, the substantive NPDES requirements will be applied to the WTP and other point source discharges.

To meet the water quality based requirements, the point source discharges from the WTP, from the West Fork underdrain culvert, and other waste areas must be limited so as to avoid causing or contributing to exceedances of the water quality criteria established for the designated beneficial use for Blackbird Creek of secondary contact recreation (not cold water biota) and for the designated beneficial use for Panther Creek of cold water biota. In accordance with the NPDES program, the water quality based requirements are established by calculating the amount of pollutant loading from Blackbird Creek that can mix with Panther Creek in a manner that is protective of cold water biota. The State of Idaho guidelines provide for a maximum mixing zone of 25% of the width of the receiving stream; however, this can be expanded through site-specific mixing zone analysis. Section 10 provides the results of the mixing zone analyses for the selected remedy.

Effluent discharge limits have not been set for the existing water treatment plant and for the West Fork underdrain culvert. The discharge limits cannot be set at the present time because the discharge limits must be set for total recoverable metals concentrations. Virtually all of the existing data for discharges from the existing water treatment plant are in terms of total recoverable metals. However, all of the loading analyses and the mixing zone analyses have been conducted using dissolved metals. This means that a metals translator must be used to calculate the dissolved/total recoverable metals ratios and to set the discharge limits. Since the data do not currently exist to develop statistically valid site-specific dissolved/total recoverable metals ratios, these data must be collected. These data will be collected during spring 2003, and the effluent discharge limits will be established in an explanation of significant difference (ESD) after the additional data are collected.

12.2.3 Construction of a Soil Cover Over the West Fork Tailings Impoundment

The West Fork Tailings Impoundment has been used as a repository for the materials removed from overbank areas along Blackbird Creek and Panther Creek since the overbank removals began in 1998. The overbank materials are much lower in arsenic and metals than the tailings that were deposited at the impoundment during the mining operations. Thus, the overbank materials can serve as an effective cover for the tailings. The overbank deposits removed from Panther Creek during the Early Actions have been spread over the portion of the impoundment south of the West Fork Blackbird Creek Channel. The additional overbank materials that will be removed from Blackbird Creek and Panther Creek during the Remedial Actions will be spread over the surface of the impoundment on both sides of the channel. The thickness of cover over the tailings will be at least 10 feet south of the channel, and at least 1 foot north of the channel. The cover will be graded to preclude drainage to the creek channel, and will be seeded to establish vegetation. The post-remediation water quality monitoring program will include stations immediately upstream and downstream from the cover area in the West Fork of Blackbird Creek. If the monitoring indicates that unacceptable levels of metals or sediments are being generated by the cover, contingency measures will be evaluated and implemented in the future.

12.2.4 Collection and Treatment of Seepage from the West Fork Tailings Impoundment

The seepage from the West Fork Tailings Impoundment is high in metals, particularly cobalt. The seepage from the tailings impoundment typically accounts for over half of the cobalt loads measured at the mouth of Blackbird Creek. The seepage comes from one discrete and multiple non-discrete sources. The discrete source is from a 42-inch culvert underdrain constructed at the bottom of the tailings impoundment. This culvert was originally constructed to serve as a bypass for the West Fork of Blackbird Creek. After the bypass channel was constructed on top of the tailings impoundment in 1993, this culvert was filled with gravel, and now serves as a drain for groundwater within the tailings. The non-discrete sources are multiple springs and seeps that issue from the vicinity of the toe of the tailings dam.

Groundwater affected by the Tailings Impoundment will be intercepted and treated. The treatment will result in a decrease in downstream cobalt concentrations in Panther Creek, such that the cobalt cleanup level of 38 μg/L can be consistently achieved in Panther Creek with acceptable mixing zones. EPA may consider a staged implementation which would allow for further cobalt toxicity analysis and biological testing, to determine if another cleanup level for cobalt is protective, before requiring treatment of groundwater from the Tailings Impoundment. This staged implementation would be scheduled so that the acceptable cobalt levels are achieved at the same time that acceptable copper levels are achieved. Through this approach, EPA could determine that another cobalt cleanup level is protective.

Three options are being considered for the collection and treatment: 1) a collection trench with pump back to the existing water treatment plant, 2) a collection trench with in-situ active treatment using a packaged water treatment plant, and 3) a slurry wall barrier with in-situ passive treatment. Each is described below.

- Collection trench with pump back to the existing water treatment plant (see Figure 12-1). A gravel-filled collection trench would be constructed with conventional excavation equipment to a depth of approximately 15 feet. The depth to bedrock in this area is approximately 20 feet or deeper. A collection trench 15 feet deep should collect the majority of seepage. The existing culvert underdrain would be extended to connect to the collection trench. A clay trench cap would be used to minimize surface water infiltration. The collection trench would drain to a vault and pump station containing two pumps. The collected water would be pumped to the 7100 dam for storage, with treatment at the existing water treatment plant. Three booster pump stations would be needed between the West Fork Impoundment and the 7100 dam. Storage vaults would be installed to buffer flows between the pump stations and to provide storage to allow draining the pipeline. Each pump station would have a backup generator, control equipment, and telemetry.

- Collection trench with in-situ active treatment using a packaged water treatment plant (see Figure 12-1). In this option, Tailings Impoundment seepage would be collected as described in the preceding section. Instead of pumping to the existing WTP, a pre-designed packaged treatment plant would be installed near the Tailings Impoundment. The treatment plant would provide lime treatment and air oxidation similar to the existing WTP. Treated water would be discharged to Blackbird Creek immediately downstream of the West Fork of Blackbird Creek.

- Slurry wall barrier with in-situ passive treatment (see Figure 12-2). In this option, a slurry wall would be constructed below the dam to intercept seepage into Blackbird Creek. A collection drain system would direct the seepage into subsurface treatment vaults. Two vaults would be constructed in the wall. Each vault would contain sorption material capable of sorbing cobalt under site conditions. A potential sorption material would be apatite. Apatite has been used for sorption of copper, zinc, and other metals discharging from mine tailings. It is believed it would work for cobalt as well, but this would need to be established via a treatability study before use. A treatability study evaluating apatite and other potential sorption media will, therefore, be conducted to determine the effectiveness and establish design criteria for an in-situ passive treatment system.

As noted in Section 10.2.1, data collected during March 2001 indicated that there were anomalously high cobalt concentrations in Panther Creek for a three to four week period. Additional monitoring will be conducted to determine the source of these high cobalt concentrations. If the high cobalt concentrations are associated with the West Fork Impoundment, it may be necessary to evaluate additional measures (e.g., larger and/or more efficient collection and treatment systems) to address the source of the high cobalt concentrations.

12.2.5 Removal of Blackbird Creek Overbank Deposits with Armoring of Selected Deposits

Many of the overbank deposits along Blackbird Creek between the WTP and the Blackbird Creek/Panther Creek confluence pose risks to human health and the environment. These risks include those deposits where the arsenic concentrations are currently above the human health cleanup levels and those deposits that could be re-mobilized during high flow events with downstream deposition at in-stream or overbank areas.

Most of the overbank deposits requiring action will be excavated and hauled to the West Fork Tailings Impoundment or the Blacktail Pit for disposal. Excavation will be conducted to the former slope or angle of repose, to natural ground surface, or to the water table, as appropriate for the individual deposits. Following excavation, the removal area will be graded as necessary for proper stormwater drainage. In a few selected areas, armoring will be used instead of removal. In addition, armoring will be added in removal areas where residual concentrations exceed the human health cleanup level or where EPA determines that there is unacceptable risk because of re-mobilization (with downstream deposition) during high flow events. Armoring of overbank deposits will generally be accomplished by placing angular riprap armor rock. The armor riprap will be installed along exposed banks of mine related sediments from the bottom anticipated scour depth to above the water surface elevation predicted for the 500-year design flood. The armor rock will be sized to resist mobilization during the 500-year design flood. See Figures 6-13a through 6-13x in the Feasibility Study for planned removal and armoring areas.

No action will be taken for overbank deposits in talus slopes. The talus rock already provides armoring, and removal would be very difficult. Removal in the talus slopes would also tend to destabilize the hillside, increasing erosion of overbank deposits into the creek.

In-stream sediments in Blackbird Creek would be addressed through natural recovery.

12.2.6 Removal of In-stream Sediments and Overbank Deposits in the Vicinity of the Panther Creek Inn

Due to the proximity to the Panther Creek Inn (PCI), the residential human health cleanup level of 100 mg/kg for arsenic will be applied to the Blackbird Creek overbank deposits between the existing berms from the Panther Creek road bridge to the Blackbird/Panther Creek confluence. In addition, overbank deposits that were not addressed during the Early Action and are found to exceed cleanup levels will be removed. Overbank deposits will be removed to the water table or the cleanup level, whichever comes first. The excavated areas will be backfilled with clean material to the pre-removal grade. In-stream sediments within the Blackbird Creek channel will be removed to the cleanup level of 490 mg/kg for arsenic or to a depth of three feet, whichever comes first. If the arsenic cleanup level is reached, backfilling within the channel will not be required. If the cleanup level is not reached, the excavated channel will be backfilled with a minimum of one foot of clean backfill material. Backfill material within the channel will be gravel or talus material with gradation similar to the removed materials.

The actions to remove and selectively stabilize overbank deposits upstream along Blackbird Creek will reduce the potential for re-contaminating the areas near the PCI where removal is conducted. In addition, the existing sediment ponds in Blackbird Creek upstream of the PCI area will be maintained and will provide additional protection. The sediment ponds were designed to store the volume of sediments that would be generated from 10 year/24-hour storm events, although not all the sediment would settle out in the ponds. To further lessen the potential for recontamination, the channel between the road and the mouth of Blackbird Creek will be deepened so that normal spring runoff will not overflow onto the overbank deposits adjacent to Blackbird Creek.

Following removal, the area will be periodically monitored to determine if the area has become re-contaminated; additional removals will be conducted if future monitoring determines that the arsenic cleanup levels for overbank and/or in-stream sediments are exceeded.

12.2.7 Establishing Institutional Controls and Physical Restrictions

Institutional controls are required to protect the remedy and to preclude uses (such as ingesting the groundwater at the mine and residential use) that would result in unacceptable risks of exposure to contaminants. All private properties along Blackbird Creek are owned by the companies that comprise the BMSG. Institutional controls for the private properties would be accomplished using an enforcement tool (a Consent Decree) with language to preclude activities on the private properties that could interfere with the remedy or cause unacceptable exposure risks. Institutional controls would be made more permanent through the use of proprietary controls, such as restrictive easements, to preclude uses that might result in unacceptable risks.

Governmental controls are anticipated for the Forest Service lands along Blackbird Creek to prevent land uses and activities that may interfere with the remedy or that could lead to unacceptable risk exposures.

Re-opening the mine or new mining activities within the Blackbird Mine cleanup area needs to be performed consistent with the selected remedy and not compromise the cleanup levels established in this ROD. Any mining activity that takes place in this area will be subject to applicable regulatory requirements including obtaining and complying with all necessary permits.

Physical restrictions on Blackbird Creek would include continued maintenance of the existing fence and gate on the Blackbird Creek road upstream of the Ludwig Gulch Road and the fencing and gate that controls access from Ludwig Gulch Road to the West Fork Tailings Impoundment. The BMSG maintains control of the gate and requires persons entering the site to sign in and sign out. Foot and horse access are not precluded; however, the frequency and duration of such activities is expected to be very limited. The gate on the Blackbird Creek road controls access to the only road to Bucktail Creek and will also limit access to the northern portion of the Blackbird Mine Site.

12.3 BUCKTAIL CREEK DRAINAGE BASIN

The Remedial Actions in the Bucktail Creek basin are shown in Figure 9-10 and include:

- Collection and treatment of Bucktail Creek groundwater seeps
- Continued operation of the Water Treatment Plant
- Diversion of Bucktail Creek
- Establishing Institutional Controls and Access Restrictions
- Operations and maintenance of early actions and remedial actions
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

12.3.1 Collection and Treatment of Bucktail Creek Seeps

Significant metals loads enter Bucktail Creek between the 7000 dam and surface water monitoring station BTSW-01.6 (approximately 0.4 mile downstream from the 7000 dam). These loads are due to discrete and non-discrete groundwater seepage and springs. The actions to address the seepage and springs include groundwater collection, with transport to the 6930 adit that drains to the existing WTP in Blackbird Creek drainage for treatment.

The seep collection will be conducted in phases. Phase 1 (which is being performed as a continuation of the Early Actions) consists of installing a groundwater interception trench below the 7000 dam. Collected water will flow by gravity to the existing pumpback station. A new discharge pipe will be installed between the pump station and the 6930 adit. The new discharge pipe will allow the existing pumps to handle the increased flows.

Under Phase 2, additional collection of groundwater will be performed. If water quality monitoring subsequent to completion of the Phase1 construction indicates that sufficient metals loads have been removed to achieve water quality cleanup levels in Big Deer Creek at all times, then Phase 2 construction would not be required. Downstream from the existing pump station, the bottom of the streambed will be filled with drainage rock and covered with a liner to create two layers in the stream. The bottom drainage layer will collect the current base flow of Bucktail Creek as groundwater. The clean surface water will flow in a pipeline over the liner. The pipeline will be perforated to allow collection of the clean surface water As an alternative, a series of extraction wells may be utilized to collect the contaminated groundwater downgradient from the initial cutoff wall. The water collected by the extraction wells would be pumped to an upgraded Bucktail pumpback station, then pumped to the 6930 adit. The extraction wells would be utilized only if it can be demonstrated that they are as effective at removal of metals loads as the gravel drain with downstream barrier in Bucktail Creek.

If the groundwater flows and metal loads in the groundwater are relatively low, passive in-situ treatment (i.e., a sorption wall) will be implemented. If the groundwater flows and/or metals loads are too high for cost-effective in-situ treatment, an interception trench will be installed to collect the groundwater from the lower layer. A pump station near this collection trench will pump water to the existing pump station for pumping to the 6930 adit. Additional and/or larger pumps will be installed at the existing pump station to handle the increased flows.

The upper sediment pond on Bucktail Creek will be removed. Materials used to construct the upper sediment dam will be hauled to the Blacktail Pit or the 7400 waste rock dump for disposal. The lower sediment pond will be retained during construction.

12.3.2 Continued Operation of Water Treatment Plant

If passive treatment is not utilized to treat the Bucktail Creek seeps, then the collected waters will be pumped to the 6930 adit, where they will be transported through the mine workings, with eventual treatment at the existing water treatment plant. The continued operation of the existing water treatment plant is described in Section 12.2.2 above.

12.3.3 Diversion of Bucktail Creek

Flows in Bucktail Creek will be diverted around South Fork Big Deer Creek, with discharge directly into Big Deer Creek. The diversion will accelerate the recovery of South Fork Big Deer Creek sediments and allow water quality cleanup levels and the copper ARAR to be met in South Fork Big Deer Creek. To divert Bucktail Creek, a pipeline will be installed from the vicinity of the Bucktail Creek Lower Sediment Dam to the discharge into Big Deer Creek just downstream from the confluence of South Fork Big Deer and Big Deer Creeks. At the discharge, a diffuser will be constructed in Big Deer Creek as necessary to minimize the mixing zone within Big Deer Creek. Pressure reducing facilities will be constructed as necessary prior to the discharge to Big Deer Creek. The pipeline will be designed to handle flows up to the 10-year design event in Bucktail Creek. Flows in excess of the pipe carrying capacity will be allowed to overflow into South Fork Big Deer Creek. The design criteria for the pipeline will use conditions prior to the Clear Creek fire in 2000. Until vegetation has become re-established in the burned areas (estimated at 5 to 15 years for undergrowth), the overflows into South Fork Big Deer Creek may be more frequent than the 10-year design assumption. During flow events as large as the 10-year event in Bucktail Creek, flows in South Fork Big Deer Creek should also be large, which should provide considerable dilution of the Bucktail Creek flows during the short duration of the overflows (the 10-year design event is a thunderstorm event). As much as feasible, the pipeline will be constructed within or parallel to the existing roadway along South Fork Big Deer Creek to minimize environmental disruption and tree cutting.

12.3.4 Establishing Institutional Controls and Access Restrictions

The Institutional Controls will be similar to those noted for the Blackbird Creek drainage basin in Section 12.2.7 above. Vehicular access will be controlled because the only road into the Bucktail Creek basin comes from the Blackbird Creek basin through the mine site. This road is controlled by the fence and gate on Blackbird Creek near Ludwig Gulch. A foot and horse trail follows Big Deer Creek. The trail can be used to access the Bucktail Creek area. Foot and horse travel will not be controlled.

12.4 PANTHER CREEK DRAINAGE AREA

The selected response action is a combination of Alternatives P-2 and P-3. The remedial actions in the Panther Creek drainage include:

- Selective removal of overbank deposits
- Establishing institutional controls
- Natural recovery of Panther Creek sediments
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

12.4.1 Selective Removal of Overbank Deposits

Selected overbank deposits will be removed at the [redacted] [redacted]/[redacted] and [redacted] properties (see Figure 12-3). These properties are located at approximately 4.5, 5.5, and 7 miles, respectively, from the mouth of Panther Creek. Soils will be removed to meet human health cleanup levels for potential future residential use (100 mg/kg arsenic). Contaminated material will be removed to the cleanup level or the water table, whichever comes first. Excavated areas will be backfilled with clean soils to the natural grade. Removal of soils would avoid the need for institutional controls at these properties unless contaminants are left at the water table above levels that pose a potential risk if subsurface soils are brought to the surface. To protect the remedy at these properties, monitoring will be conducted following significant runoff events to ensure that these properties do not become re-contaminated due to remobilization of upstream sediments (particularly Blackbird Creek sediments).

12.4.2 Establishing Institutional Controls

At some or all of the overbank deposits at the [redacted] property (and [redacted], if necessary) institutional controls may be utilized to protect human health under the future residential scenario. These institutional controls would include land use restrictions to preclude future residential use of this property. Proprietary controls, such as a conservation easement, would be established on all or portions of the contaminated overbank deposits at this property. The proprietary controls would be layered with informational devices implemented by EPA. The grantee of the easement would be a third party, preferably a government entity, that would ensure that the land is not developed for residential uses in the future.

If the current property owner is not willing to grant the easement, or if a third party is not identified that is willing to accept the easement, then it would not be possible to implement institutional controls at the [redacted] property. In this case, removal would be conducted similar to that described in Section 12.4.1 above.

At some of the private properties where overbank soil was removed as part of the Early Actions, elevated concentrations of arsenic remain beneath the clean backfill at the water table. Institutional controls are needed to address activities that might result in exposure to the contaminated subsurface soils in the water table at the following properties: Riprap Bar 1, Riprap Bars 3 and 5, Deep Creek, Campground 2, [redacted] 2/1, [redacted] 1 (Ditch Area), [redacted] Lower Pasture ([redacted] 4/1 and 4/2), [redacted] Upstream Low Bar, [redacted] Low Bar 1, [redacted] Low Bar 2, Noranda Pasture 3, Cobalt 1, 4, and 5, and the Panther Creek Inn area.

12.4.3 Natural Recovery of Panther Creek Sediments

Panther Creek sediments will be addressed through natural recovery.

12.5 LONG-TERM OPERATION AND MAINTENANCE

Long-term operation and maintenance (O&M) will be required for the facilities included in both the Early Actions and the Remedial Actions described above. Several O&M manuals have been prepared for the various features of the Early Actions that specify protocols to assure that the facilities are properly operated and maintained. Similar O&M manuals will be prepared for the Remedial Actions. O&M will be required in perpetuity.

12.6 MONITORING

Monitoring will be required to maintain facilities, evaluate effectiveness of Early Actions and Remedial Actions at meeting water quality and sediment goals, and to document recovery of benthic invertebrate and fish populations. Water quality monitoring will be conducted at the water treatment plant(s) discharge and the West Fork Tailings Impoundmenat treatment discharge and in the various streams. In addition, monitoring will be conducted of various components of the remediation system to ensure effectiveness. This monitoring will include selected overbank areas along Panther Creek following significant runoff events to ensure that these areas do not exceed human health cleanup levels because of remobilization of upstream sediments (particularly Blackbird Creek sediments).

Details of the overall monitoring plan will be established as part of the Remedial Design/ Remedial Action. The monitoring plan will be developed in consultation with the State and Trustees. From a biological standpoint, the goals of the monitoring plan will be to assure that the sediment and surface water cleanup levels are met on a consistent basis. In addition, the monitoring plan will include elements to assure that the remedial actions are as effective as assumed, that the NPDES and mixing zone requirements are sufficient to support beneficial uses, and that the zones of passage adjacent to the mixing zones are adequate for fish passage.

12.7 SUMMARY OF ESTIMATED COSTS

The total present worth cost of the Selected Remedy is $15,400,000 based on a present worth discount rate of 7% and 30-year O & M. This value is for the combined costs for the Blackbird Creek Drainage Alternative BB-7, Bucktail Creek Drainage Alternative BT-5 and Panther Creek Drainage Alternative Combined P-2/P-3. The costs are summarized in Tables 12-1 through 12-5.

The cost summary provided is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.8 CONTINGENT ACTIONS FOR BLACKBIRD CREEK, BUCKTAIL CREEK DRAINAGE AREA AND PANTHER CREEK DRAINAGE

There is uncertainty whether some of the components of the remedial action will be effective in meeting the RAOs and cleanup levels. Therefore, monitoring and evaluations are needed after construction of the remedial alternative. Based on the monitoring results and further evaluations, contingent actions may be necessary for some areas of the site in the future if cleanup levels are not met. These actions could include, but would not necessarily be limited to:

- Actions to reduce the hydraulic head upstream of the cutoff wall on upper Blackbird Creek to reduce seepage through the wall and metals loading from groundwater discharging to Blackbird Creek. As an alternative, groundwater could be intercepted downgradient from the cutoff wall and pumped to the existing WTP for treatment.

- Increases to the water storage and/or treatment capacity, and/or revisions to the treatment schedule, if there is insufficient capacity to meet water storage and treatment needs.

- Additional removal of overbank deposits along Blackbird Creek.

- Run-on/run-off controls for the cover on the West Fork Tailings Impoundment, if monitoring indicates excessive erosion or water quality impacts from runoff.

- Measures to reduce the water table beneath the West Fork Tailings Impoundment, if the water table begins to rise to a level that threatens the stability of the dam.

- Additional collection and treatment of Bucktail Creek seeps, if they result in unacceptable metals loading to Big Deer Creek.

- Removal of Bucktail Creek sediments and/or overbank materials, or installation of a passive (or semi-passive) treatment system near the confluence of the South Fork Big Deer Creek and Big Deer Creek, if water quality goals in Big Deer Creek are not achieved because of metals leaching from sediments/overbank materials along Bucktail Creek.

- Alternatives to address metals discharges to South Fork Big Deer Creek from groundwater and/or overbank materials if water quality goals in South Fork Big Deer Creek are not achieved.

- Additional removals along Panther Creek if monitoring following storm events result in deposition of overbank deposits that exceed remediation goals.

- Monitoring the selected response action to determine if the mixing zone for the copper water quality standard and cobalt cleanup level is protective of cold water biota to meet the substantive NPDES requirements for both Panther Creek and Big Deer Creek. If monitoring indicates that the mixing zones are not protective of cold water biota, alternatives will be evaluated to meet the substantive NPDES mixing zone requirements.

- Alternatives to address metals loads to Big Deer Creek downstream from South Fork Big Deer Creek if monitoring indicates that these loads result in exceedances of water quality goals in Big Deer Creek.

12.9 EXPECTED OUTCOMES OF THE SELECTED REMEDY

The remedial action is expected to reduce human health risks in overbank deposits along Blackbird Creek and Panther Creek. Water quality and aquatic biota conditions are expected to be protective of all life stages of resident and anadromous salmonids and other fishes in Panther Creek and resident salmonids and other fishes in South Fork of Big Deer and Big Deer Creeks. In addition, the remedial action is expected to restore and maintain sediment quality and aquatic biota conditions capable of supporting all life stages of resident and anadromous salmonids and other fishes in Panther Creek and resident salmonids and other fishes in South Fork of Big Deer and Big Deer Creeks. In Blackbird Creek and Bucktail Creek, the remedial action is expected to achieve the non-numeric narrative goals provided in Section 8.

SECTION 13

STATUTORY DETERMINATIONS

Under Section 121 of CERCLA and the NCP, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements, are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets the statutory requirements.

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will protect human health and the environment in each of the drainage areas as follows:

Blackbird Creek Drainage Basin

- Collection and treatment of water, including the upper Meadow Creek seeps and seepage from the West Fork Tailings Impoundment will reduce concentrations of copper and cobalt in Blackbird and Panther Creeks so that the water quality in Panther Creek meets cleanup levels protective for aquatic organisms, including endangered species, and the non-numeric narrative cleanup goal for Blackbird Creek is met.

- Operation of the Water Treatment Plant will be continued to meet water quality cleanup levels.

- Capping and grading the West Fork Tailings Impoundment will reduce direct contact with tailings, reduce surface water transport of tailings and reduce storm water infiltration so that risks to human health are reduced; and to support meeting water quality cleanup levels in Panther Creek protective for aquatic organisms and the non-numeric narrative cleanup goal for Blackbird Creek.

- Collection and treatment of seepage from the West Fork Tailings Impoundment so that the water quality in Panther Creek meets cleanup levels protective for aquatic organisms, including endangered species, and the non-numeric narrative cleanup goal for Blackbird Creek is met.

- Removal and stabilization of overbank deposits will reduce direct contact with tailings and will reduce surface water transport of tailings so that risks to human health downstream are reduced.

- Removal of Blackbird Creek in-stream sediments and overbank deposits in the vicinity of the Panther Creek Inn (PCI) will reduce direct contact with contaminated material so that risks to human health are reduced.

- Establishing institutional controls and access restrictions will prevent uses that are inconsistent with or interfere with the remedy.

- Natural recovery of sediments will meet sediment cleanup levels.

Bucktail Creek Drainage Basin

- Collection and treatment of Bucktail Creek groundwater seeps below the 7000 dam will reduce the concentrations of copper and cobalt in Bucktail Creek, South Fork Big Deer Creek and Big Deer Creek so that the water quality in South Fork Big Deer Creek and Big Deer Creek meets cleanup levels protective for aquatic organisms and the non-numeric narrative cleanup goal for Bucktail Creek is met.

- Operation of the Water Treatment Plant will be continued to meet water quality cleanup levels in Bucktail Creek.

- Diversion of Bucktail Creek to Big Deer Creek will reduce the concentrations of copper in South Fork Big Deer Creek without causing exceedances in Big Deer Creek so that water quality in South Fork Big Deer Creek can achieve Idaho WQS and the cobalt cleanup level.

- Establishing institutional controls and access restrictions will prevent uses that are inconsistent with or interfere with the remedy.

- Natural recovery of Bucktail Creek, South Fork of Big Deer Creek and Big Deer Creek sediments will meet sediment cleanup levels.

Panther Creek Drainage Area

- Selective removal of overbank deposits will reduce human exposure to arsenic contaminated material so that risks to human health are reduced.

- Establishing institutional controls will reduce human exposure to arsenic contaminated material so that risks to human health are reduced.

- Natural recovery of Panther Creek sediments will meet sediment cleanup levels.

13.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The selected remedy will comply with all action-specific, chemical-specific and location-specific Federal and State ARARs that have been identified. These ARARs are listed below.

Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02). These rules designate uses that are to be protected in waters of the State of Idaho and establish standards of water quality protective of those uses.

The State of Idaho rules designate Panther Creek, Big Deer Creek and South Fork of Big Deer Creek for all uses, including protection of cold water aquatic life, salmonid spawning and secondary contact recreation. The State of Idaho has removed the designated aquatic life uses (through a use attainability analysis(UAA)) for Lower Blackbird and West Fork Blackbird Creeks (downstream of the clean water reservoir). These UAAs were approved by EPA. These waters have only secondary contact recreational use. The State has removed the aquatic life and recreational use designations from Bucktail Creek with a UAA which was also approved by EPA.

The State of Idaho rules establish water quality standards that are to be protective of the designated uses. The Idaho WQS for copper and arsenic that were submitted to EPA prior to May 30, 2000, and any changes adopted by Idaho and approved by EPA between May 30, 2000 and the date of this ROD, are applicable to the selected remedial action.

Clean Water Act Section 304 - Federal Ambient Water Quality. Section 304(a)(1) of the Clean Water Act requires EPA to develop, publish and revise criteria for water quality. Section 121(d)(2)(A) of CERCLA provides that the remedial action shall attain the water quality criteria established pursuant to Section 304 of the Clean Water Act. Section 121(d)(2)(B) of CERCLA provides that, "In determining whether or not any water quality criteria under the Clean Water Act is relevant and appropriate under the circumstances of the release or threatened release, the President shall consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available." EPA has reviewed EPA's published National Recommended Water Quality Criteria dated November 2002 (AWQC) and has found that the AWQC for human health based on "consumption of organisms only" is relevant and appropriate for evaluating arsenic in the creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big Deer Creek and Big Deer Creek). In evaluating this AWQC for these creeks, EPA utilized the AWQC of 10^{-4} risk level for arsenic of 14 ug/L. EPA has reviewed the data on these creeks and has determined that the 95% UCLs for both Panther Creek, South Fork Big Deer Creek and Big Deer Creek do not exceed the AWQC criteria of 14 ug/L.

Clean Water Act National Pollutant Discharge Elimination System (NPDES) Permit (40 CFR 122-125, 40 CFR 440). All point source discharges, including those associated with the water treatment plant, the West Fork Tailings Impoundment, and other waste areas, must meet the substantive requirements of the NPDES regulations. These regulations establish a national permit program for discharges to waters of the United States. These regulations identify specific effluent limitation guidelines for discharges within specific industrial categories. The NPDES regulations also require, where a discharge causes or has the reasonable potential to cause or contribute to an excursion of water quality standards, that effluent limitation be established to meet beneficial uses. Such water quality based effluent limits are calculated based on achieving water quality criteria in the receiving water.

In accordance with the Clean Water Act and the State of Idaho WQS, point source discharges may allow a mixing zone. A mixing zone is an allocated impact zone where the cleanup levels can be exceeded. The Idaho WQS provide the criteria for evaluating the size, configuration and location of a mixing zone. This evaluation includes a determination that the mixing zone does not cause unreasonable interference with or danger to beneficial uses and provides guidance regarding the size of the mixing zone. (IWQS 58.01.02.060) Monitoring is necessary to ensure that the mixing zone does not interfere with beneficial uses.

The requirements for point source discharges established under the NPDES regulations and the Idaho regulations, including the mixing zone guidelines, are applicable to the point source discharges into Blackbird Creek. The effluent limitations for these point sources must take into consideration the potential impacts to water quality in Panther Creek which is protected for aquatic life. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

The requirements for point source discharges established under the NPDES regulations and the Idaho regulations, including the mixing zone guidelines establish relevant and appropriate guidelines for the diversion of Bucktail Creek into Big Deer Creek. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

Clean Water Act Stormwater Multi-Sector General Permit for Industrial Activities (65 FR 64746-64880 and 40 CFR 122.26). The substantive requirements of the Stormwater Multi-Sector General Permit for Industrial Activities apply to elements of the selected remedy that result in discharges of stormwater from "industrial activities". "Industrial activities" include inactive mining facilities as well as the construction and operation of mine waste repositories. Best management practices (BMPs) must be used, and appropriate monitoring performed, to ensure that stormwater runoff does not exceed state water quality standards.

National Primary Drinking Water Standards (40 CFR 141). These regulations, promulgated pursuant to the Safe Drinking Water Act, address contamination in community drinking water systems. These regulations are not applicable because there are no community drinking water systems within the Site. However, the regulations are relevant and appropriate for any groundwater associated with the Site that has mining related contaminants and is used as a source of drinking water. By final rule effective February 22, 2002, EPA lowered the MCL for arsenic from 0.05 mg/L to 0.01 mg/L (66 FR 7061). While community water systems have until January 2006 to comply with the new MCL for arsenic, EPA has determined that the new MCL is relevant and appropriate presently for ensuring that drinking water is protective of human health.

State of Idaho Drinking Water Regulations (IDAPA 58.01.08.050). The purpose of these regulations is to control and regulate the design, construction, operation, maintenance, and quality of public drinking water systems in order to protect public health. These regulations are essentially equivalent to the federal primary and secondary drinking water regulations of 40 CFR 141 and 40 CFR 143, respectively. These regulations are not applicable, but are relevant and appropriate for groundwater associated with the Site that has mining related contaminants and is used as a source of drinking water.

Safety of Dams, State of Idaho Rules and Regulations (Chapter 17, Section 42-1714, Idaho Code and provisions of Section 42-1709 through 42-1721, Idaho Code). These requirements are intended to provide a guide for the establishment of acceptable standards for the construction of and safety evaluation of new or existing dams. These rules are considered applicable to response activities at the Blackbird site that include the use of dams for surface water impoundment because these rules apply to all new dams, to existing dams being altered or repaired and maintenance activities to existing dams as provided in the rules.

Idaho Mine Tailings Impoundment Structure Rules and Regulations (Chapter 17, Section 42-1714, Idaho State Code). These rules and regulations apply to structures constructed, enlarged, or altered after July 1, 1978, used for the purpose of storing mine tailings slurry, that are more than 30 feet in height from toe to the maximum crest. These regulations are relevant and appropriate to response actions, including disposal of additional materials and alteration of the West Fork Tailings Impoundment.

State of Idaho Stream Channel Alteration (IDAPA 37, Title 03, Chapter 07). The objectives of regulations under IDAPA 37, Title 03, Chapter 07 are to protect stream channels and their associated environments against alteration so that fish and wildlife habitat, aquatic life, recreation, aesthetics and water quality are also protected. Substantive portions of these requirements are applicable to response actions at the Blackbird site that involve alteration of stream channels.

Endangered Species Act (16 USC 1531 et seq.) This law and implementing regulations identify threatened and endangered species and establish requirements necessary for their protection. The ESA and implementing regulations are applicable to activities of the Selected Remedy that could affect federally designated threatened or endangered species and/or their habitat. EPA has prepared a Biological Assessment for the selected remedy. Consistent with the Section 7 consultation requirements of the Endangered Species Act, EPA has provided the National Marine Fisheries Service and US Fish and Wildlife Service with a copy of the Biological Assessment.

The Biological Assessment prepared by EPA concluded that the selected remedy is not likely to adversely affect any threatened or endangered species. In a letter dated November 25, 2002, the US Fish and Wildlife Service notified EPA that it has designated critical habitat for bull trout in the Panther Creek drainage. In the same letter, the US Fish and Wildlife Service concurred with EPA's "may affect, not likely to adversely affect" determination relating to the bald eagle, gray wolf and lynx. However, the US Fish and Wildlife Service letter indicates that a determination of "may affect, likely to adversely affect" is appropriate for bull trout in Panther Creek and Big Deer Creek due to concerns about construction related releases, concerns about the two mixing zones and a need for a specific monitoring plan. In a letter dated December 17, 2002, the National Marine Fisheries Service (NMFS) expressed similar findings that a determination of "may affect, likely to adversely affect" is appropriate for Snake River spring/summer chinook salmon and steelhead, designated critical habitat and essential fish habitat due to concerns about construction related releases, concerns about the mixing zones and a need for a specific monitoring plan.

EPA will continue to work with US Fish and Wildlife Service and the National Marine Fisheries Service ("Services") to address their concerns and to meet the requirements of the Endangered Species Act. EPA intends to proceed with selection of this remedial action in accordance with Section 7(d) which provides that the Federal agency shall not make any irreversible or irretrievable commitment of resources which has the effect of foreclosing the formulation or implementation of any reasonable and prudent measures. In the event that the Services propose reasonable and prudent alternatives for the remedial action and/or conservation recommendations, EPA will work with Services to implement such measures and will evaluate the need for modification to the selected remedy through an ESD or amendment to this ROD.

Rivers and Harbors Act, Section 10 regulations (33 CFR Parts 320 through 330). These regulations are applicable to activities in or near navigable waters. They prohibit unauthorized obstruction or alteration of navigable waters.

Clean Water Act, Section 404 (40 CFR 230, 33 CFR 320-330). Section 404 of the Clean Water Act and associated regulations prohibit discharge of dredge or fill material to wetlands. The Army Corps of Engineers implements the Section 404 permit program which provides guidelines for the identification of wetlands and implements protective requirements for actions involving wetlands. Section 404 is applicable if regulated wetlands are identified and potentially impacted by the selected remedy.

Executive Order 11990, Protection of Wetlands. This Executive Order requires federal agencies to avoid adversely impacting wetlands, minimize wetland destruction and preserve the value of wetlands. EPA policy for implementing this Executive Order is promulgated in 40 CFR 6. This Executive Order and regulations are applicable to remedial activities that could affect wetlands.

Executive Order 11988, Floodplain Management. This Executive Order requires federal agencies to evaluate the potential effects of actions that take place in floodplains and to avoid adverse impacts. EPA policy for carrying out the provisions of this Executive Order is promulgated in 40 CFR 6. This Executive Order and regulations are applicable to remedial activities within the floodplains along creeks and streams.

Fish and Wildlife Coordination Act (16 USC 661 et seq.) This statute requires federal agencies to consider the effect projects may have on fish and wildlife and to mitigate loss or damage to these resources. This statute is applicable to the selected remedy.

Migratory Bird Treaty Act (MBTA) (16 USC 703 - 712). The MBTA makes it unlawful to pursue, capture, hunt or take actions adversely affecting a broad range of migratory birds. The MBTA and its implementing regulations are relevant and appropriate to remedial activities that could affect any protected migratory birds. The selected remedy will be carried out in a manner that avoids taking or killing of protected migratory bird species, including individual birds or their nests.

Idaho Classification and Protection of Wildlife (IDAPA 13.01.06). These regulations are relevant and appropriate to remedial activities that could affect wildlife species protected by the State of Idaho.

USFS Regulations for Public Land Closures (36 CFR 261.50). These regulations authorize the Regional Forester to issue orders which close or restrict use of areas, roads or trails on National Forest System lands. This regulation is applicable to the closures or use restrictions of areas, roads, or trails on National Forest System lands.

USFS Regulations for Special Use Authorization (36 CFR 251.53). These regulations govern the issuance of special use authorizations for National Forest System land. Special use authorizations are applicable to rights-of way, reservoirs, canals, ditches, pipes and pipelines, for the impoundment, storage and transportation of water and for system and related facilities for generation, transmission and distribution of electricity. The substantive requirements of these regulations are applicable for remedial actions that require any of these facilities on National Forest System land.

USFS Regulations for Roadless Areas (36 CFR 294.12(b)(2). These regualtions govern the construction of roads in inventoried roadless areas and specifically authorize the constuction of roads when needed to conduct a response action under CERCLA. To the extent that road construction is conducted in an inventoried roadless areas, any substantive requirements of these regulations are applicable to such construction activities.

To Be Considered

The following requirements are to be considered during the design and implementation of the remedial action.

USFS Policies. The US Forest Service policies that are to be considered during implementation of the remedial action on US Forest Service land include those requirements that govern public health and pollution control facilities (FSM 7400) and that govern water storage and transmission (FSM 7500).

13.3 COST EFFECTIVENESS

The selected remedy is cost-effective. In making this determination, the following definition set forth in the NCP was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 430(f)(1)(ii)(D)). Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides "overall effectiveness" in terms of balancing the long-term effectiveness and permanence; short-term effectiveness and reduction in toxicity, mobility and volume. The "overall effectiveness" of the selected remedy was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this selected remedy represents a reasonable value for the money spent.

The estimated present worth cost of the selected remedy is $15.4 million. Although other alternatives are less expensive, the cobalt contamination in Blackbird Creek and Panther Creek and the copper contamination in South Fork of Big Deer Creek are not addressed. The selected remedy's additional cost for treatment of the seeps from the West Fork Tailings Impoundment to reduce cobalt concentrations in Blackbird Creek and Panther Creek provides a significant increase in protection of the environment and is cost effective relative to this environmental benefit. In addition, the selected remedy's additional cost for bypassing loadings to South Fork Big Deer Creek provides a significant increase in protection of the environment and is cost effective relative to the environmental benefit.

13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment and disposal and considering State and community acceptance.

13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy utilizes alternative treatment (or resource recovery) technologies to the maximum extent practicable for this site. The remedy utilizes treatment of contaminated surface water and groundwater that has been impacted by metals leading from source materials. Treatment of the remaining threats, waste rock and tailings, was not found to be practicable due to the large volume.

13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the cleanup levels are protective and that the remedy is, or will be, protective of human health and the environment.

SECTION 14

DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy has not significantly changed from the proposed plan. However, there have been some changes in the ROD from the proposed plan that are provided below.

- The cleanup level for copper in surface water has been changed to the State WQS from the federal AWQC (see Section 8).

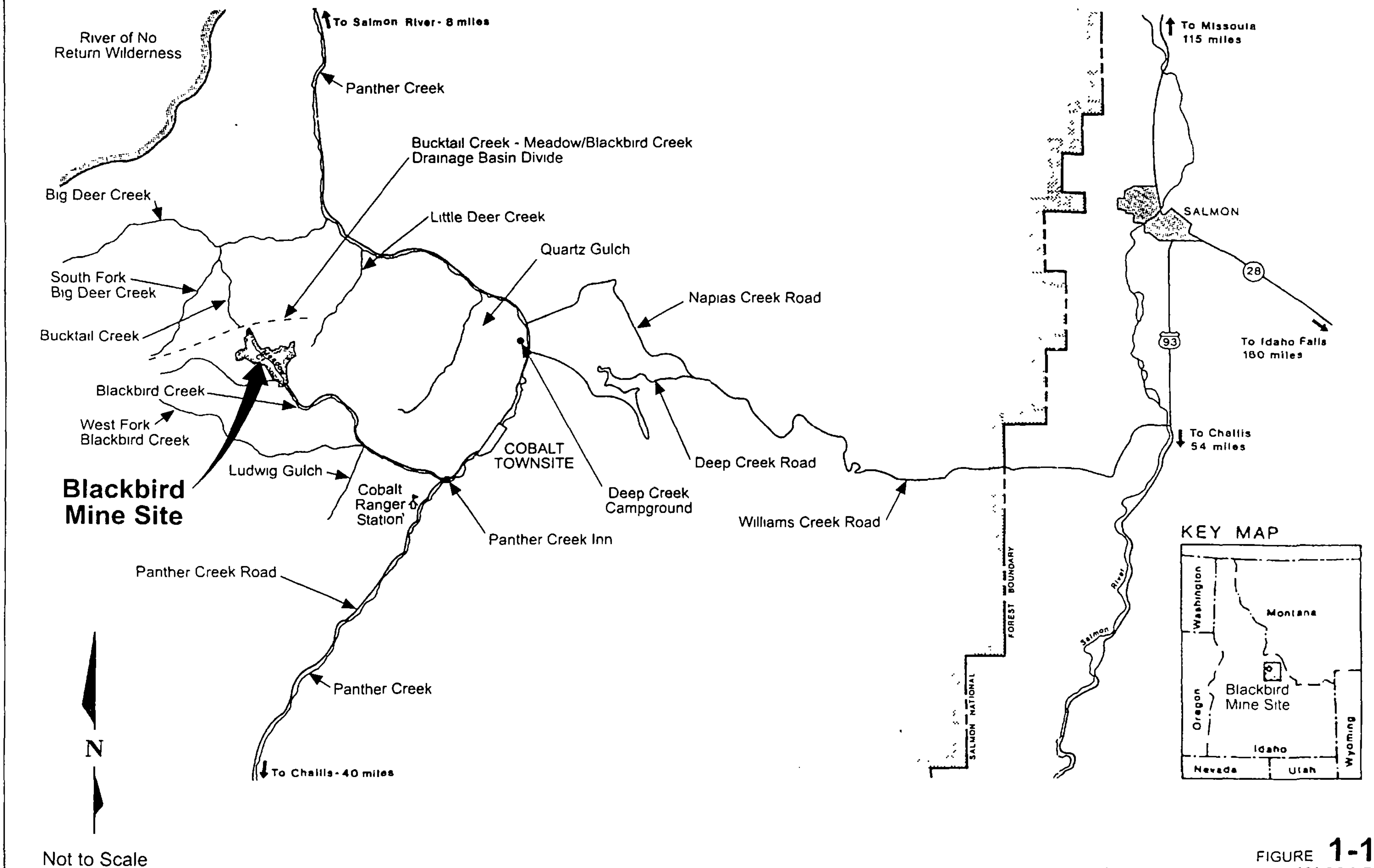
- The cleanup level for arsenic in Blackbird Creek is based on the State of Idaho water quality standard of 50 μg/L. The cleanup level for arsenic in Panther Creek, Big Deer Creek and South Fork Big Deer Creek is 14μg/L. This cleanup level of 14 μg/L is based on the AWQC at 10^{-4} for protection of human health from "consumption of organisms". (Section 8)

- Groundwater cleanup levels at the mine have been established (see Section 8).

- A mixing zone analysis for cobalt in Panther Creek has been provided (see Section 10).

- NPDES requirements have been determined to be an ARAR in Big Deer Creek (see Sections 9 and 13).

A



SOURCE ERT 1982

FIGURE **1-1**

REGIONAL OVERVIEW MAP

BMSG/BLACKBIRD MINE SITE/ID

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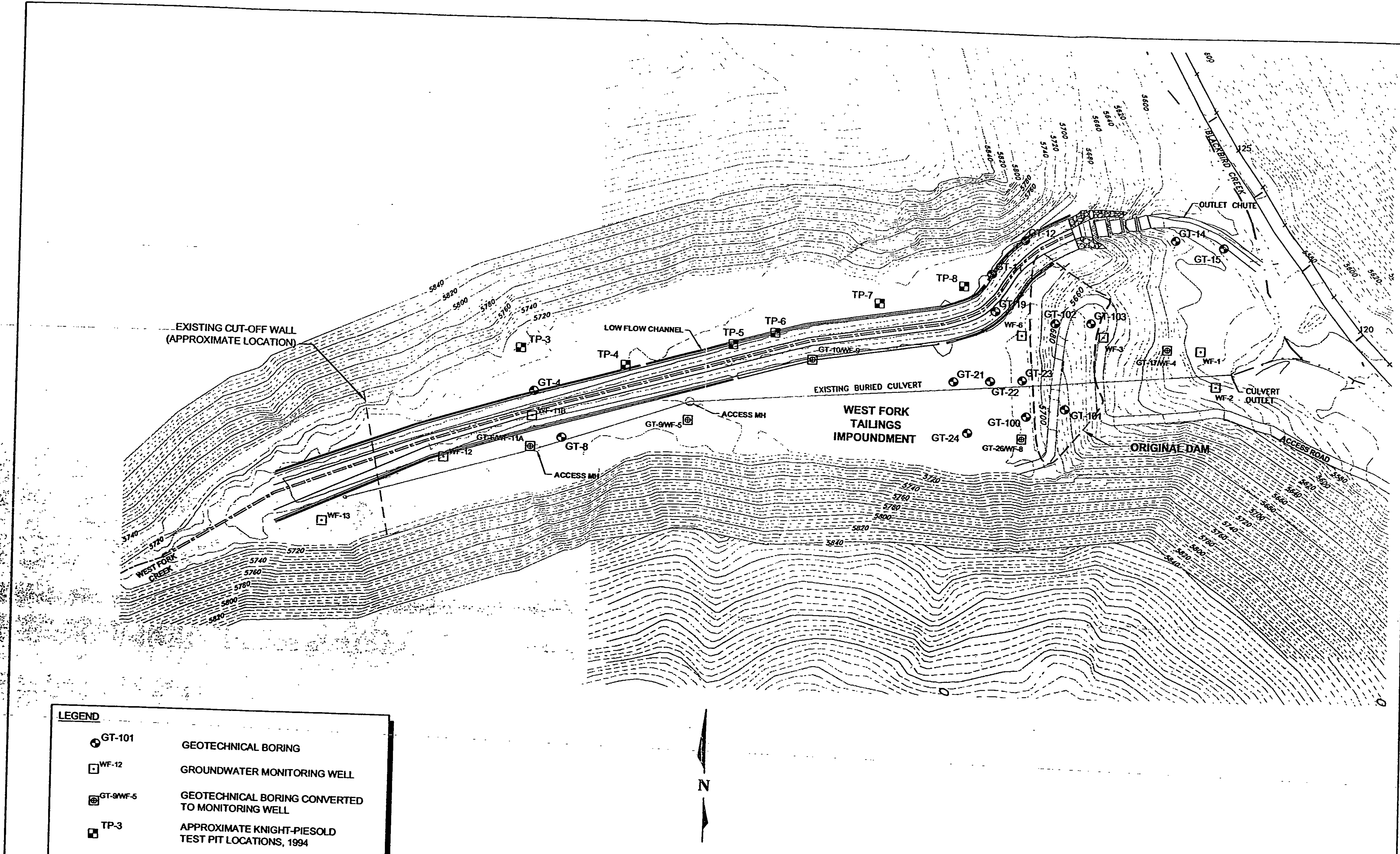

FIGURE **2-1**
WEST FORK TAILINGS IMPOUNDMENT-EXISTING SITE PLAN
FEASIBILITY STUDY/BLACKBIRD MINE SITE/ID

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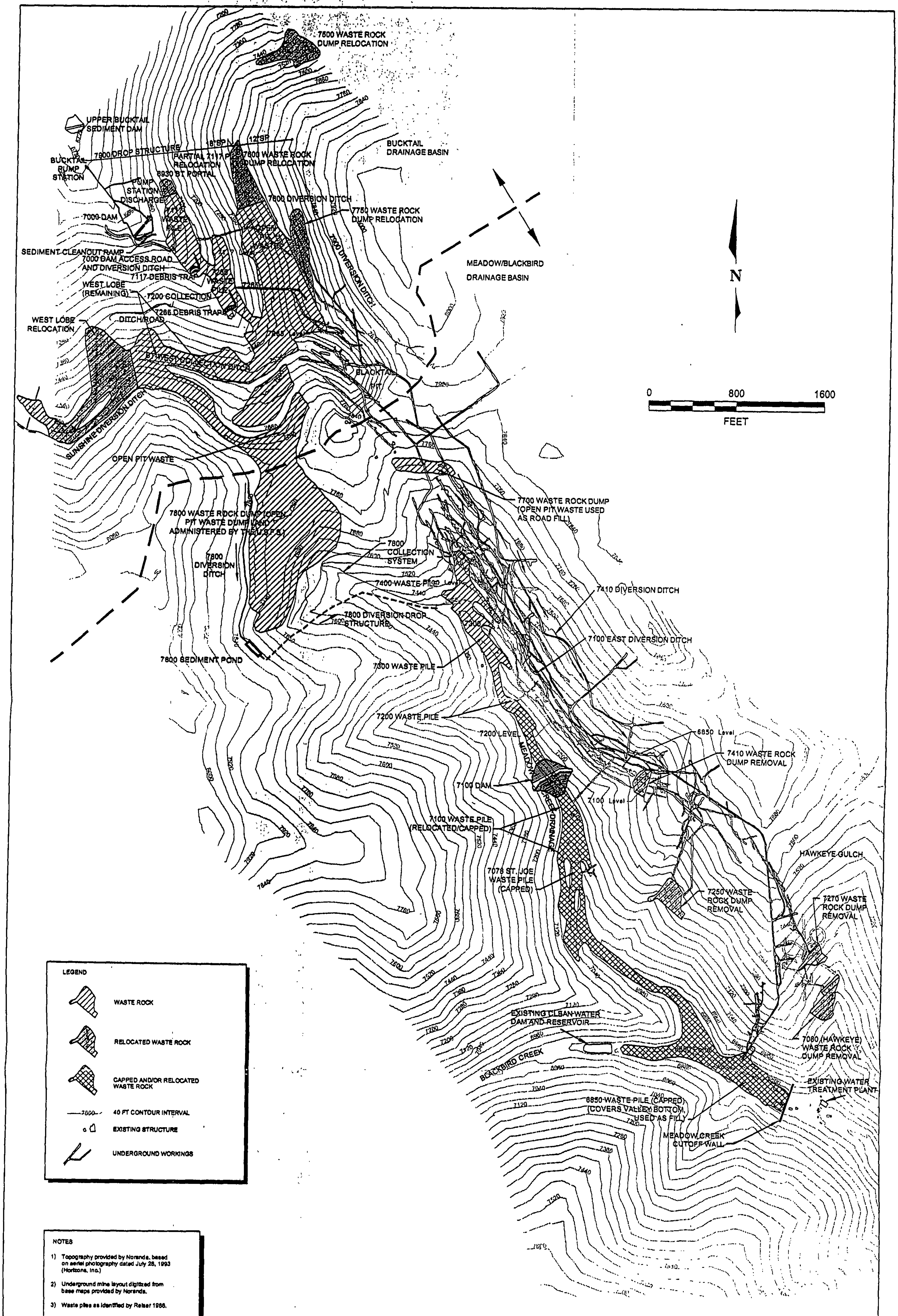

A-3

FIGURE **2-2**
MINE SITE WITH EARLY ACTIONS
FEASIBILITY STUDY/BLACKBIRD MINE SITE/ID

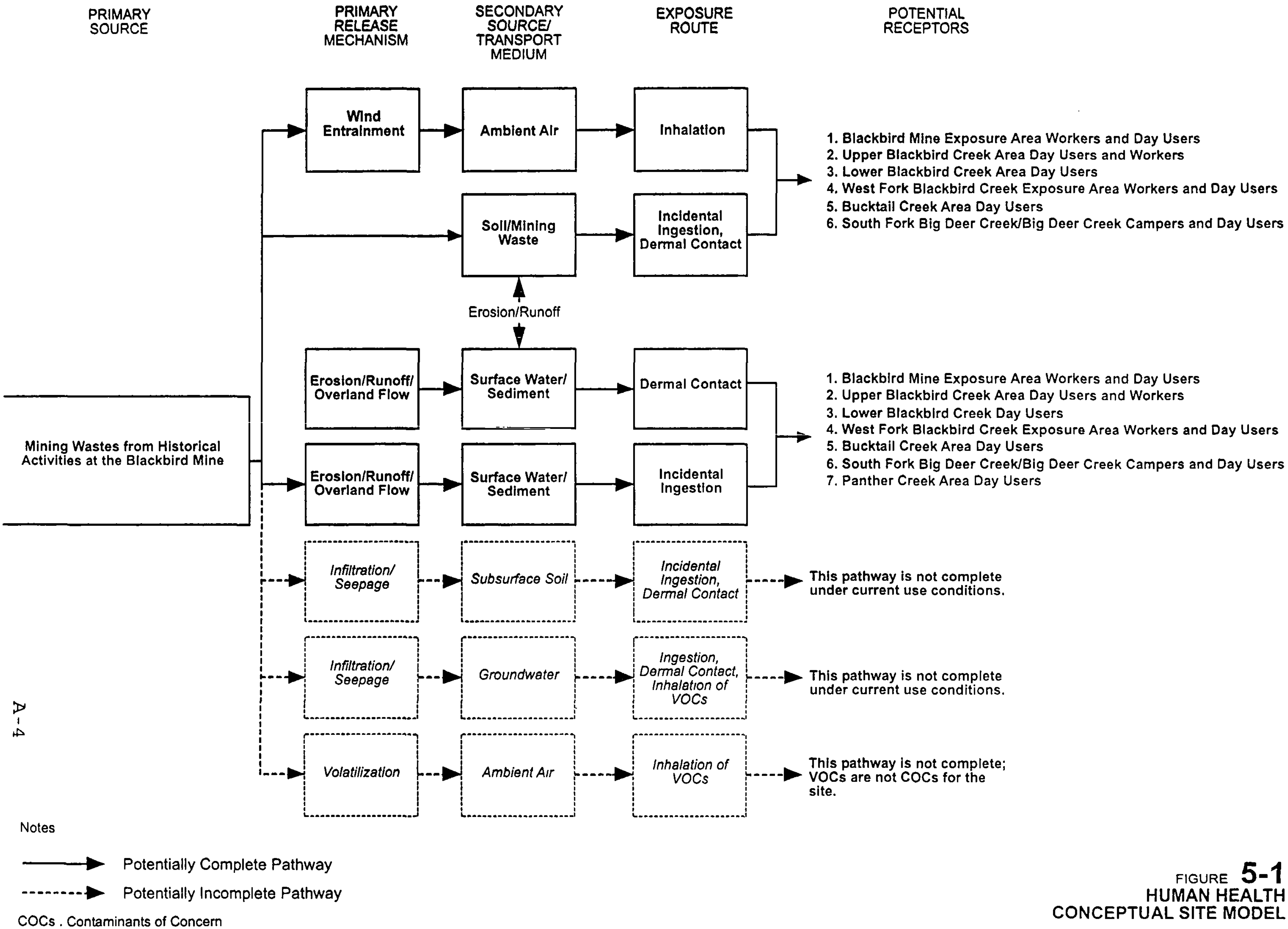

FIGURE **5-1**
HUMAN HEALTH CONCEPTUAL SITE MODEL

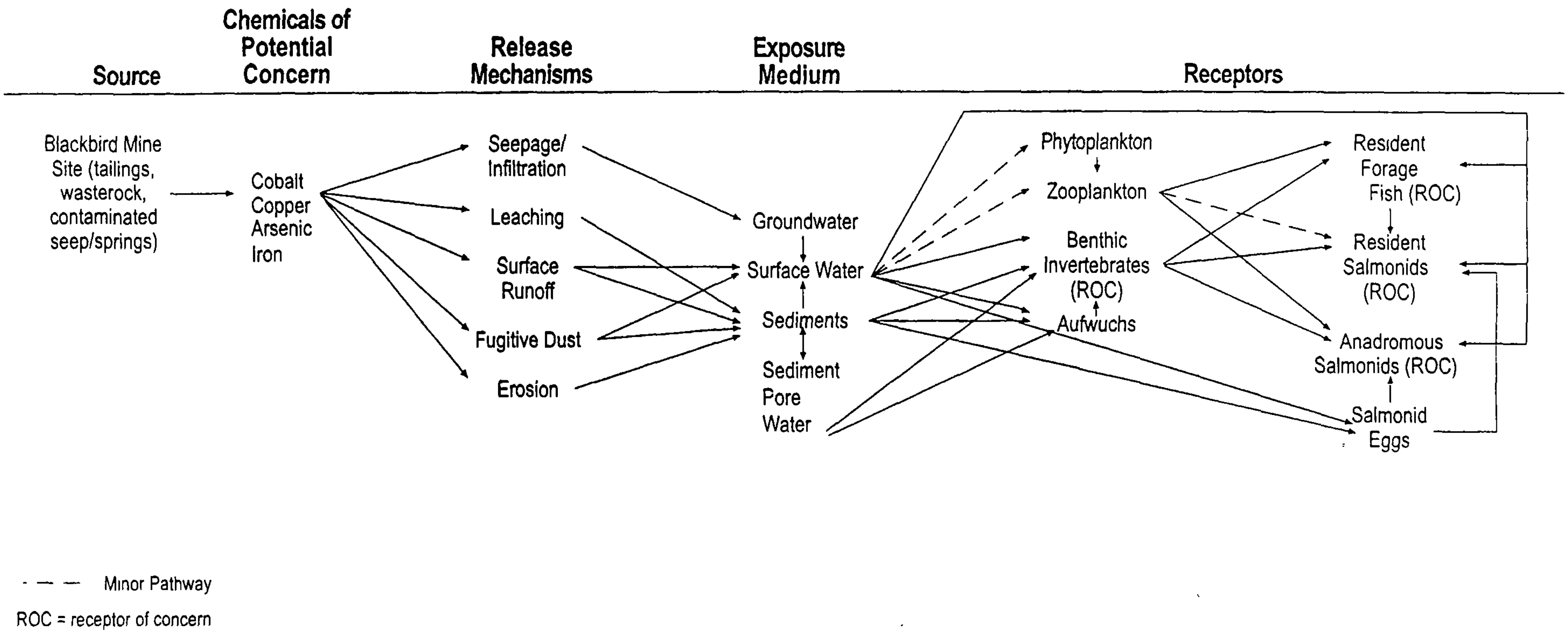

FIGURE **5-2**
AQUATIC CONCEPTUAL SITE MODEL

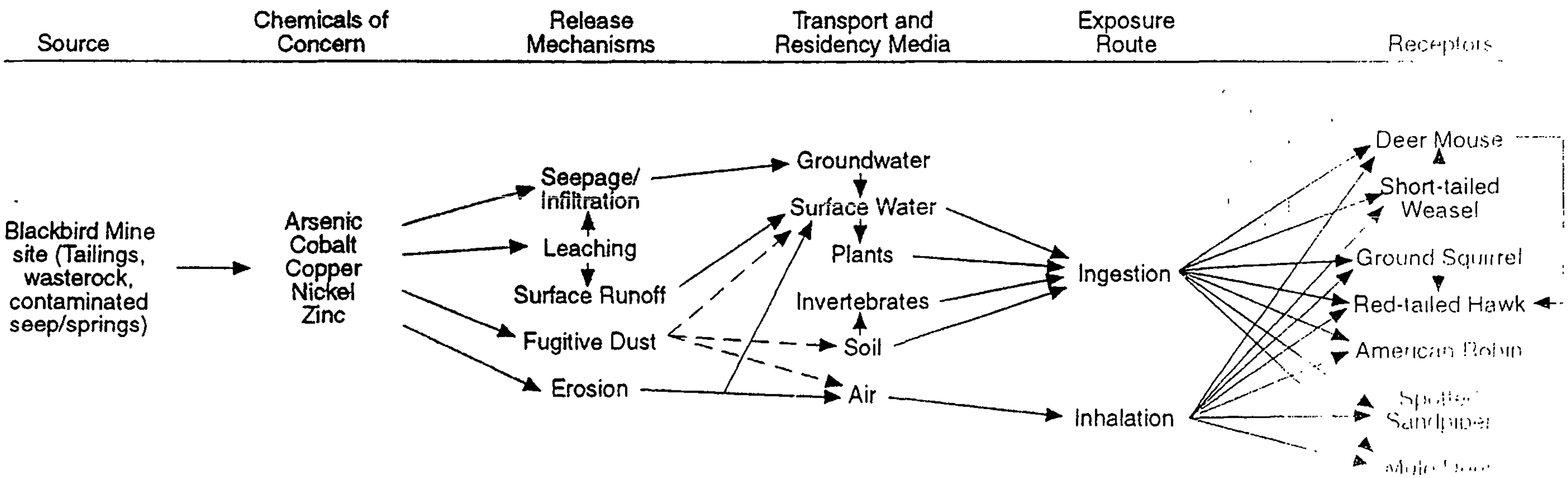

FIGURE **5-3**
TERRESTRIAL CONCEPTUAL MODEL
NORANDA/BLACKBIRD MINE/ID

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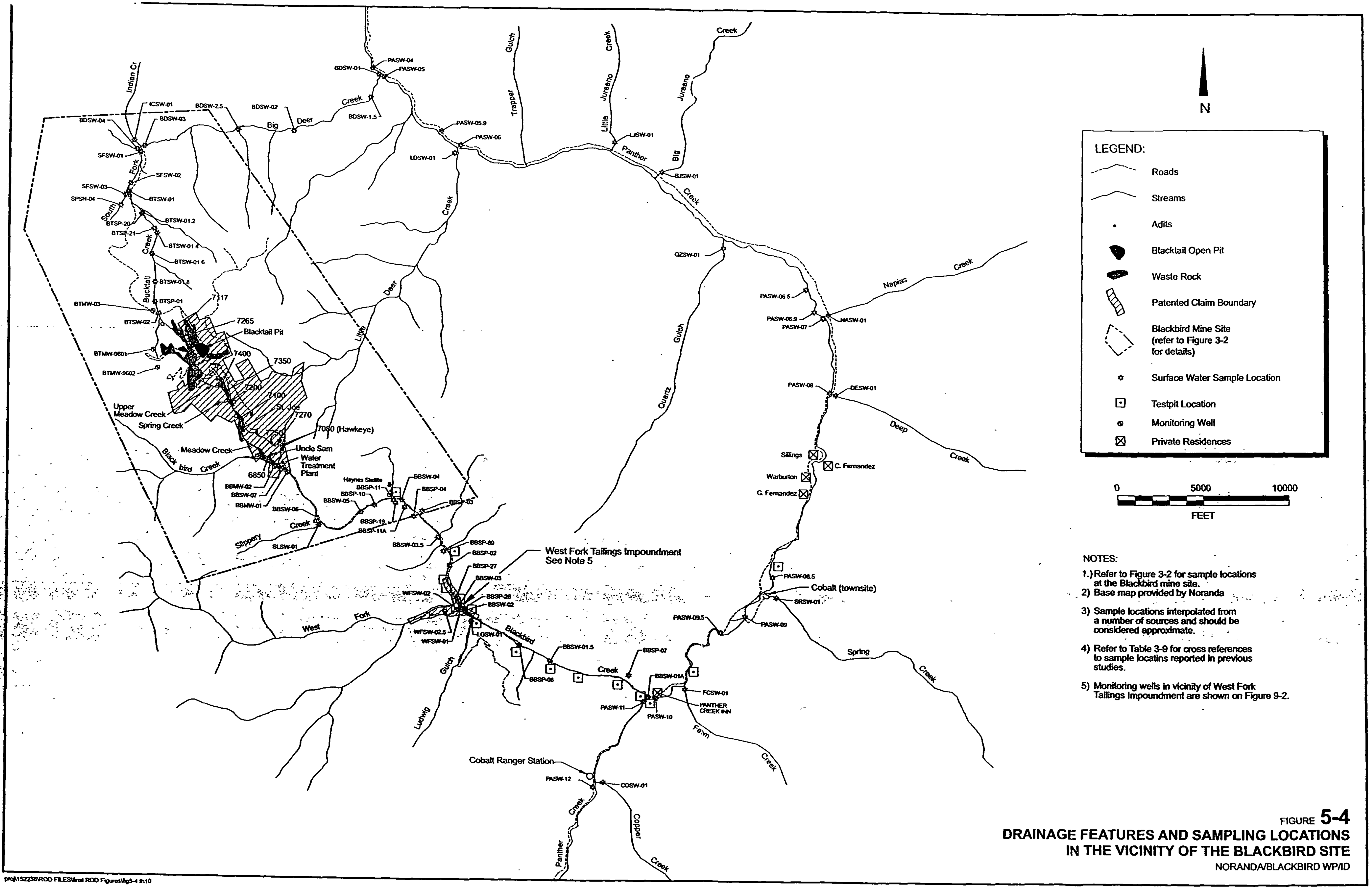

FIGURE **5-4**
DRAINAGE FEATURES AND SAMPLING LOCATIONS IN THE VICINITY OF THE BLACKBIRD SITE
NORANDA/BLACKBIRD WP/ID

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After Golder Associates

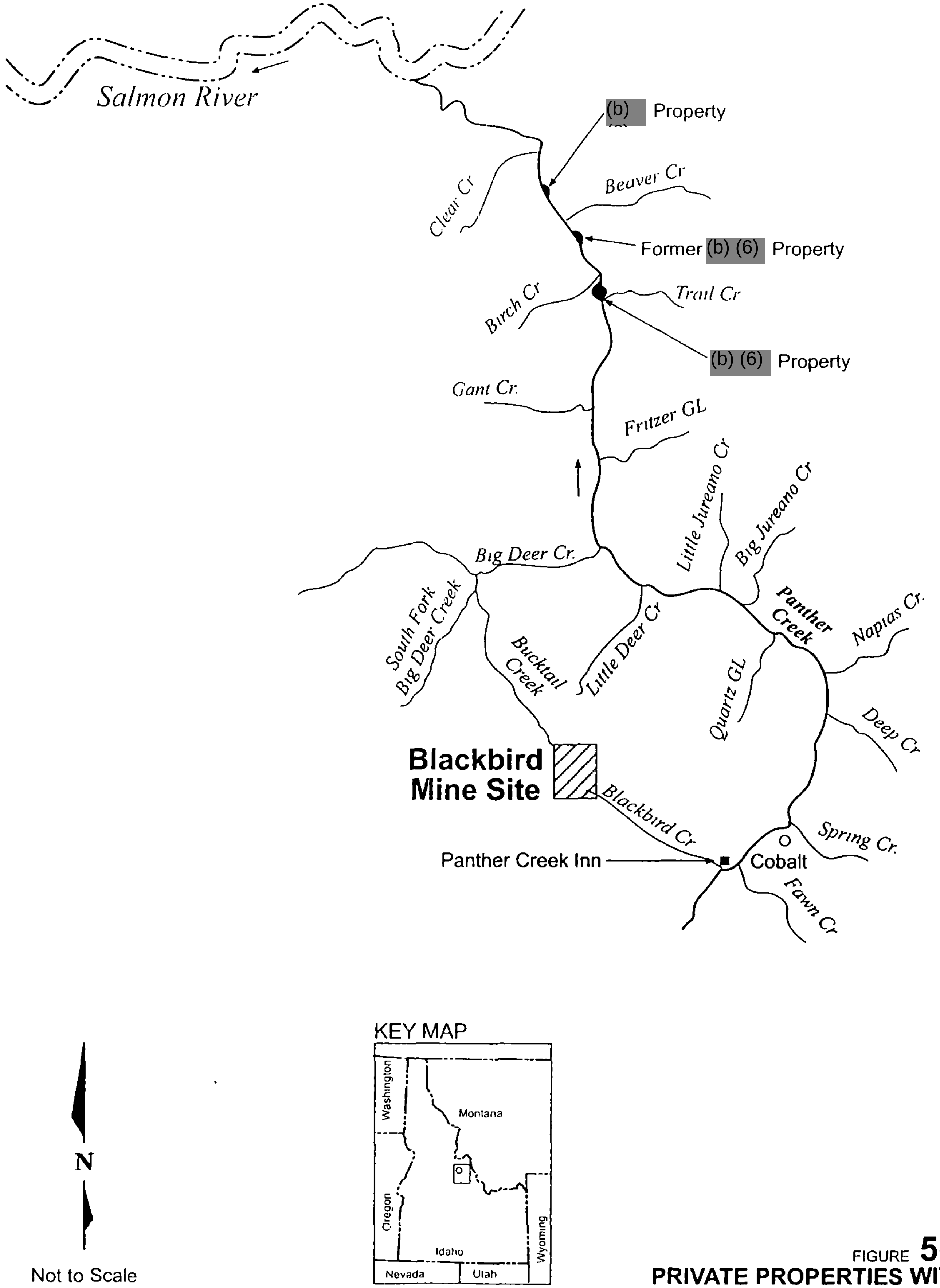

FIGURE **5-5**
PRIVATE PROPERTIES WITH FUTURE HUMAN HEALTH RISKS
BMSG/BLACKBIRD MINE SITE/ID

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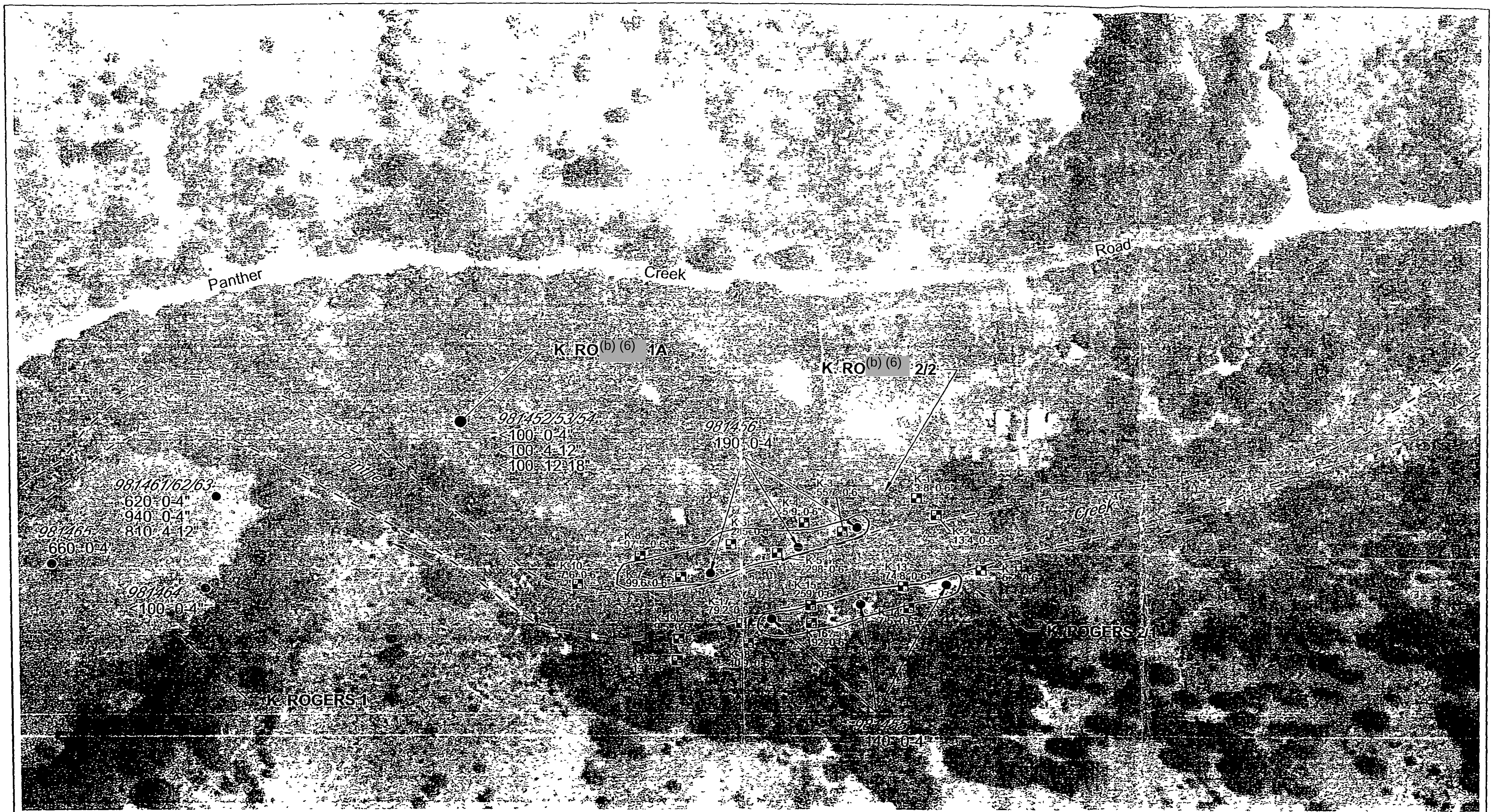

LEGEND

- 991407 — 1999 SAMPLE LOCATION AND DESIGNATION
- 990051 — COMBINED 1999 SURFACE SAMPLE AND TESTPIT LOCATION AND DESIGNATION
- ST-5 0-6" — 2000 SAMPLING LOCATION
- ESTIMATED EXTENT OF AREA EXCEEDING PRG

ARROW INDICATES DIRECTION OF FLOW

NOTE ACTUAL SAMPLE DEPTHS PRESENTED ON FIGURE

ARSENIC CONCENTRATIONS (mg/kg): <5 0-4", 450 4-8", 1000 8-12" — SAMPLE INTERVALS (in)

APPROXIMATE SCALE
1" 100'
0 100 200
FEET

N

FIGURE 5-6
OVERBANK DEPOSIT SAMPLING LOCATIONS - (b) (b) (6) PROPERTY
AREA 2/1 & 2/2
BMSG/BLACKBIRD MINE/ID

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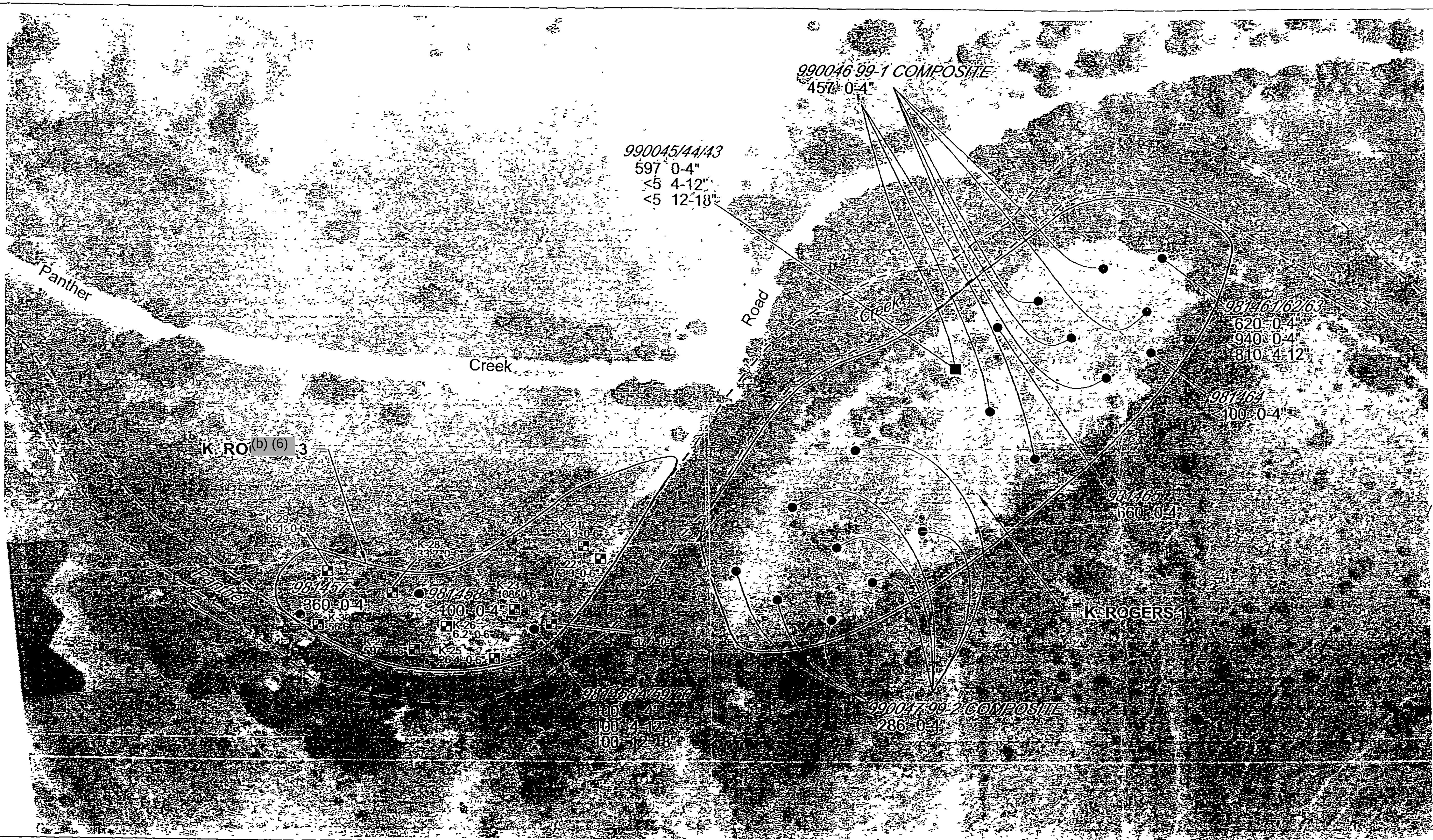


LEGEND

● *991407*	1999 SAMPLE LOCATION AND DESIGNATION
■ *990051*	COMBINED 1999 SURFACE SAMPLE AND TESTPIT LOCATION AND DESIGNATION
ST-5 0-6"	2000 SAMPLING LOCATION
	ESTIMATED EXTENT OF AREA EXCEEDING PRG

ARROW INDICATES DIRECTION OF FLOW

NOTE: ACTUAL SAMPLE DEPTHS PRESENTED ON FIGURE

ARSENIC CONCENTRATIONS (mg/kg) { <5 0-4" / 450 4-8" / 1000 8-12" } SAMPLE INTERVALS (in)

APPROXIMATE SCALE
1" 100'
0 100 200
FEET

N

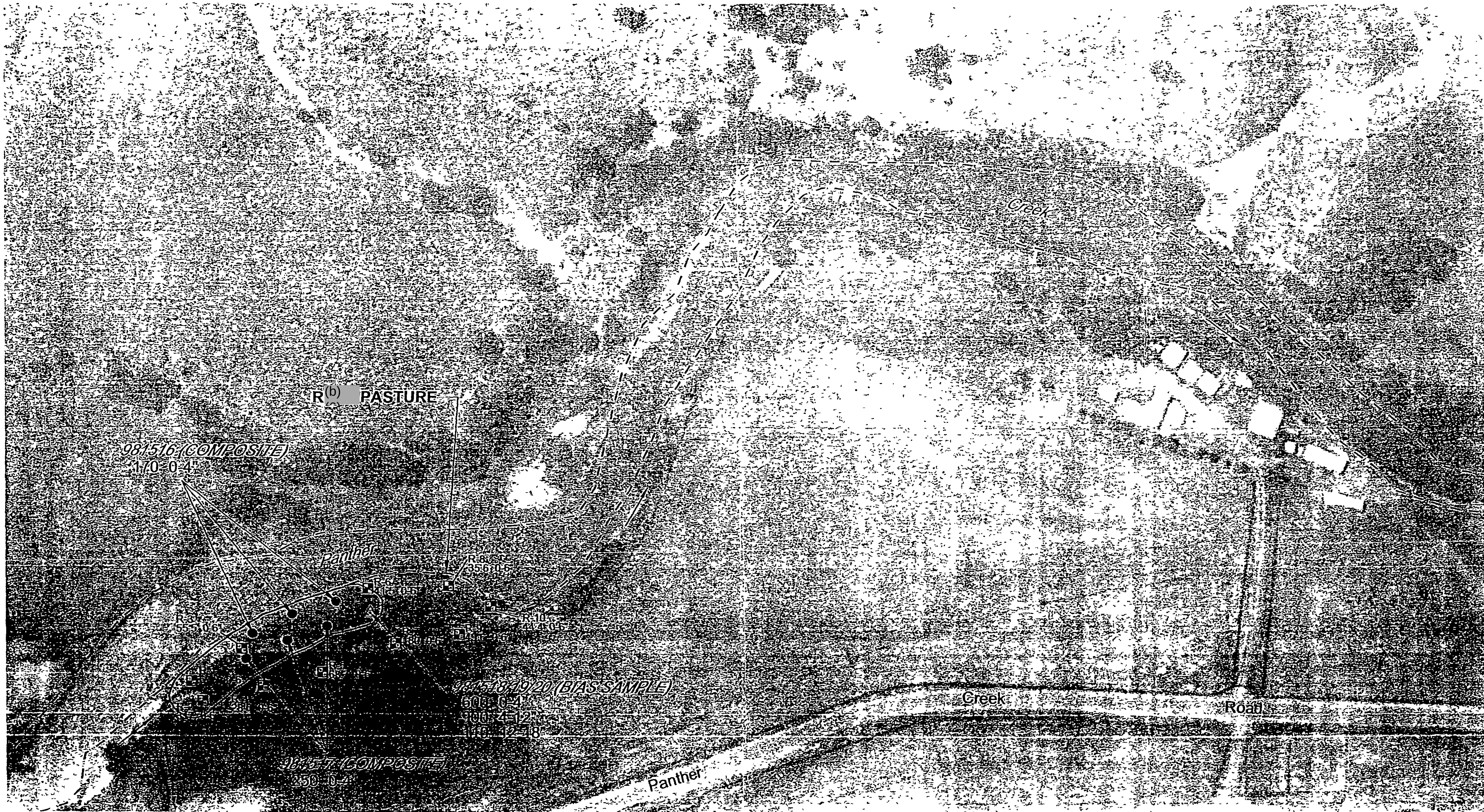
FIGURE **5-7**

OVERBANK DEPOSIT SAMPLING LOCATIONS - (b) (b) (6) PROPERTY - AREA 3

BMSG/BLACKBIRD MINE/ID

Drawing file 94315950040500F04.dwg Dec 16 2002 - 4:06pm

Golder Associates



LEGEND

● *991407*	1999 SAMPLE LOCATION AND DESIGNATION
■ *990051*	COMBINED 1999 SURFACE SAMPLE AND TESTPIT LOCATION AND DESIGNATION
ST-5 0-6"	2000 SAMPLING LOCATION
(line)	ESTIMATED EXTENT OF AREA EXCEEDING PRG

← ARROW INDICATES DIRECTION OF FLOW

NOTE: ACTUAL SAMPLE DEPTHS PRESENTED ON FIGURE

ARSENIC CONCENTRATIONS (mg/kg) { <5 0-4" / 450 4-8" / 1000 8-12" } SAMPLE INTERVALS (in)

APPROXIMATE SCALE
1" 100'
0 100 200
FEET

N

FIGURE **5-8**

OVERBANK DEPOSIT SAMPLING LOCATIONS - R(b)[redacted] PROPERTY

BMSG/BLACKBIRD MINE/ID

Drawing file 94315950040500F05.dwg Dec 16, 2002 - 4:08pm

Golder Associates

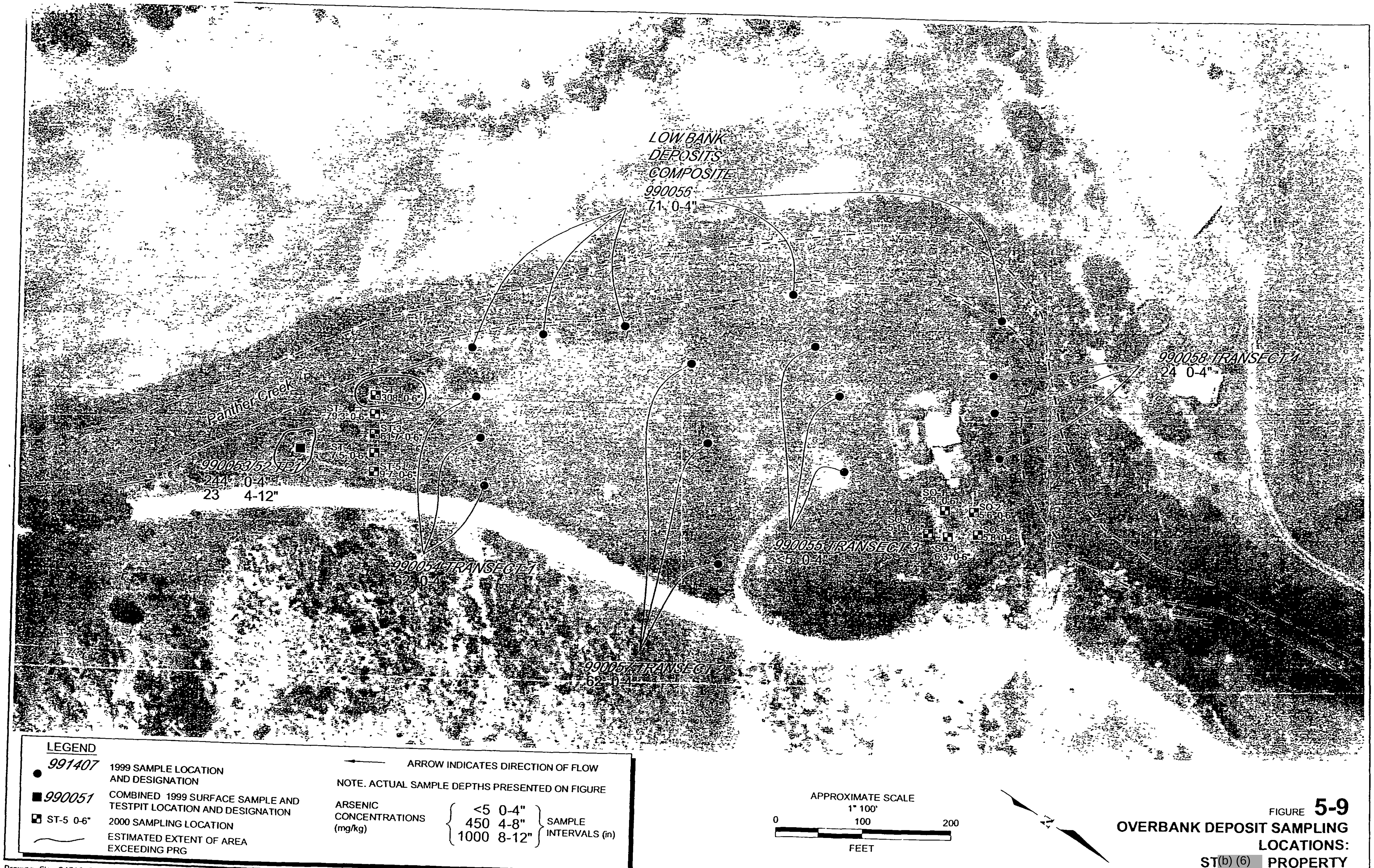


FIGURE **5-9**

OVERBANK DEPOSIT SAMPLING LOCATIONS: ST(b) (6) PROPERTY

BMSG/BLACKBIRD MINE/ID

Golder Associates

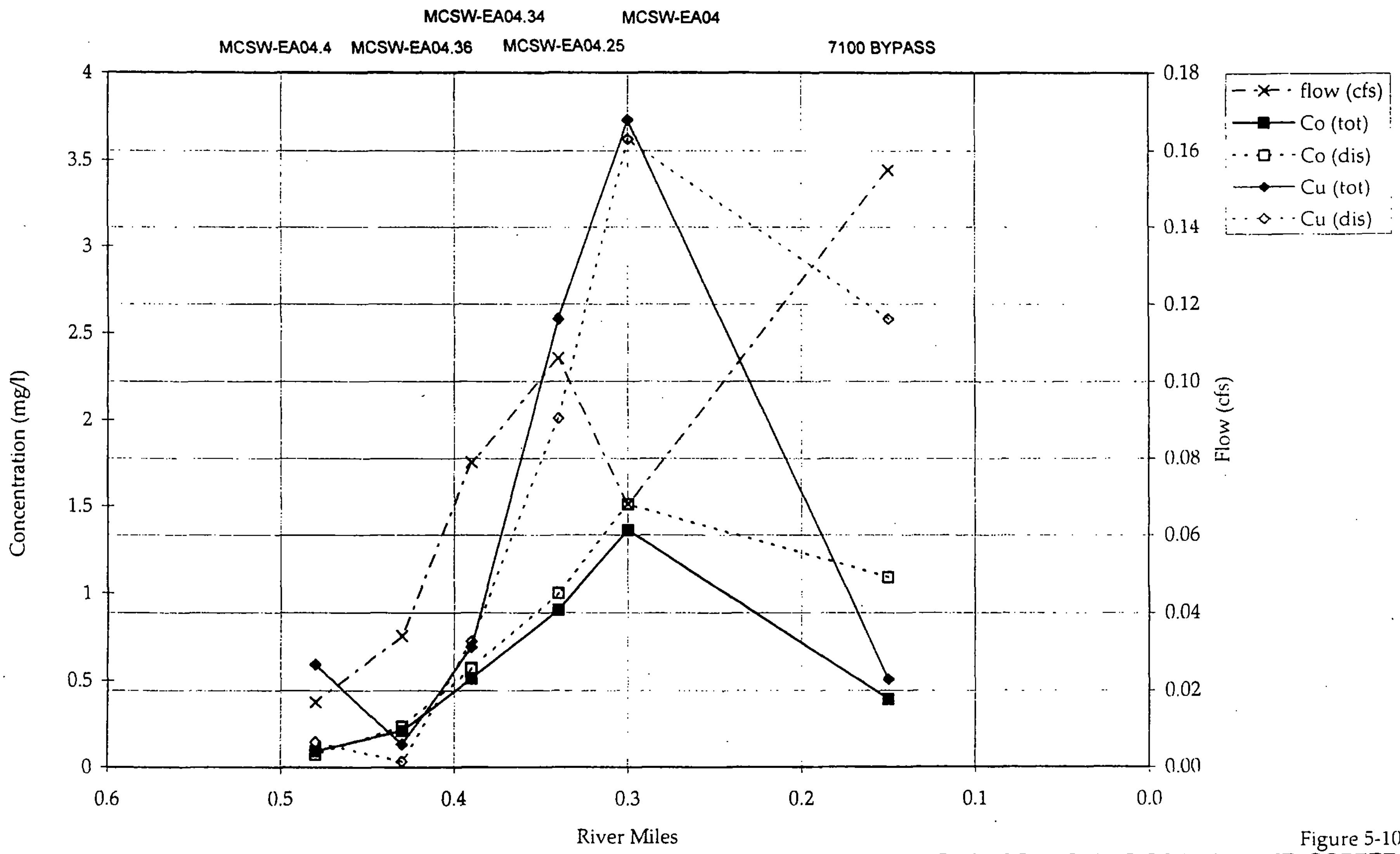


Figure 5-10
MEADOW CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION SPRING 2000
BMSG/2000 DATA SUMMARY/ID
943-1595.003, 11/27/00, SPRING_MCSYN_00.xls

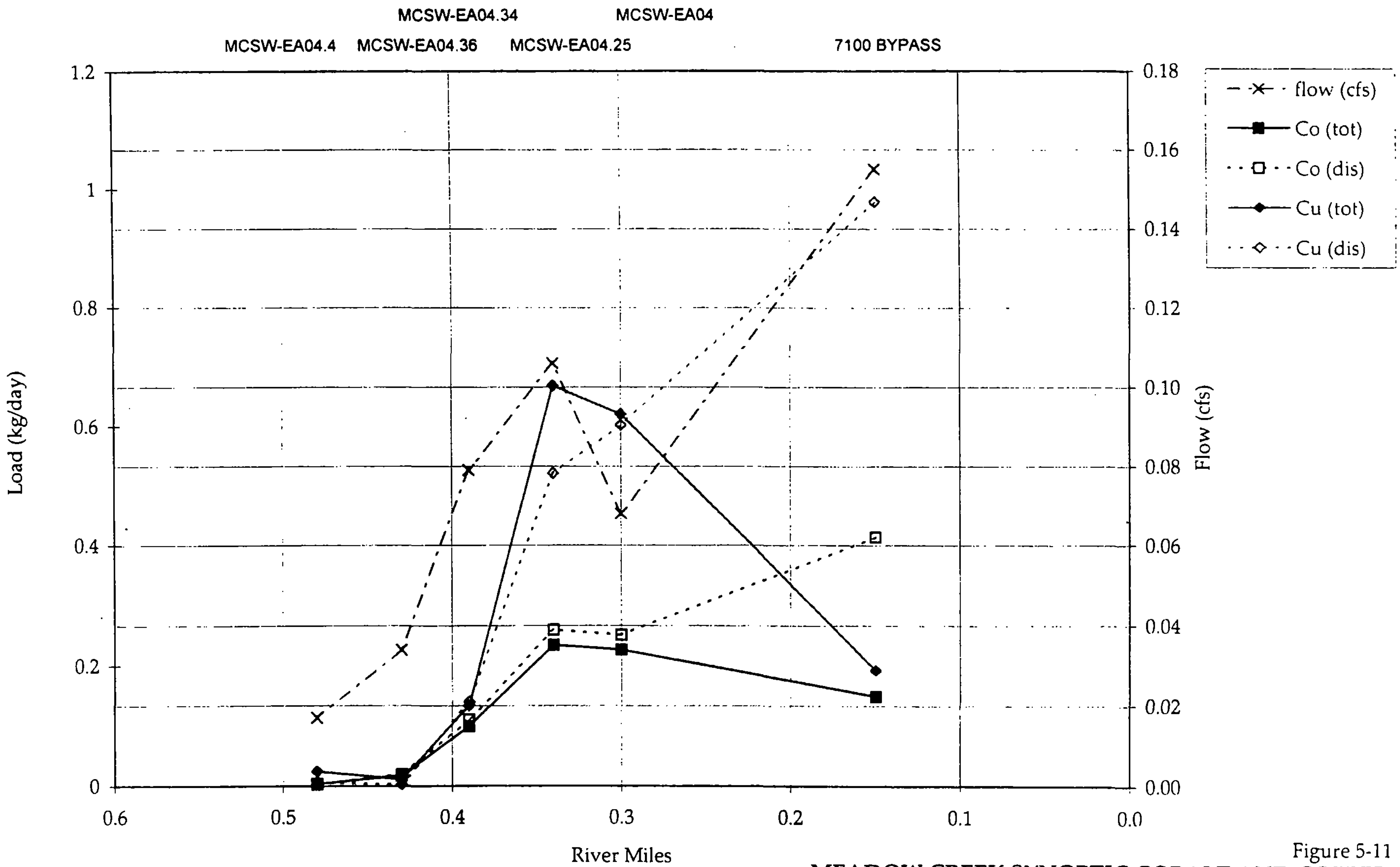


Figure 5-11
MEADOW CREEK SYNOPTIC COBALT AND COPPER LOADING SPRING 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, SPRING_MCSYN_00.xls

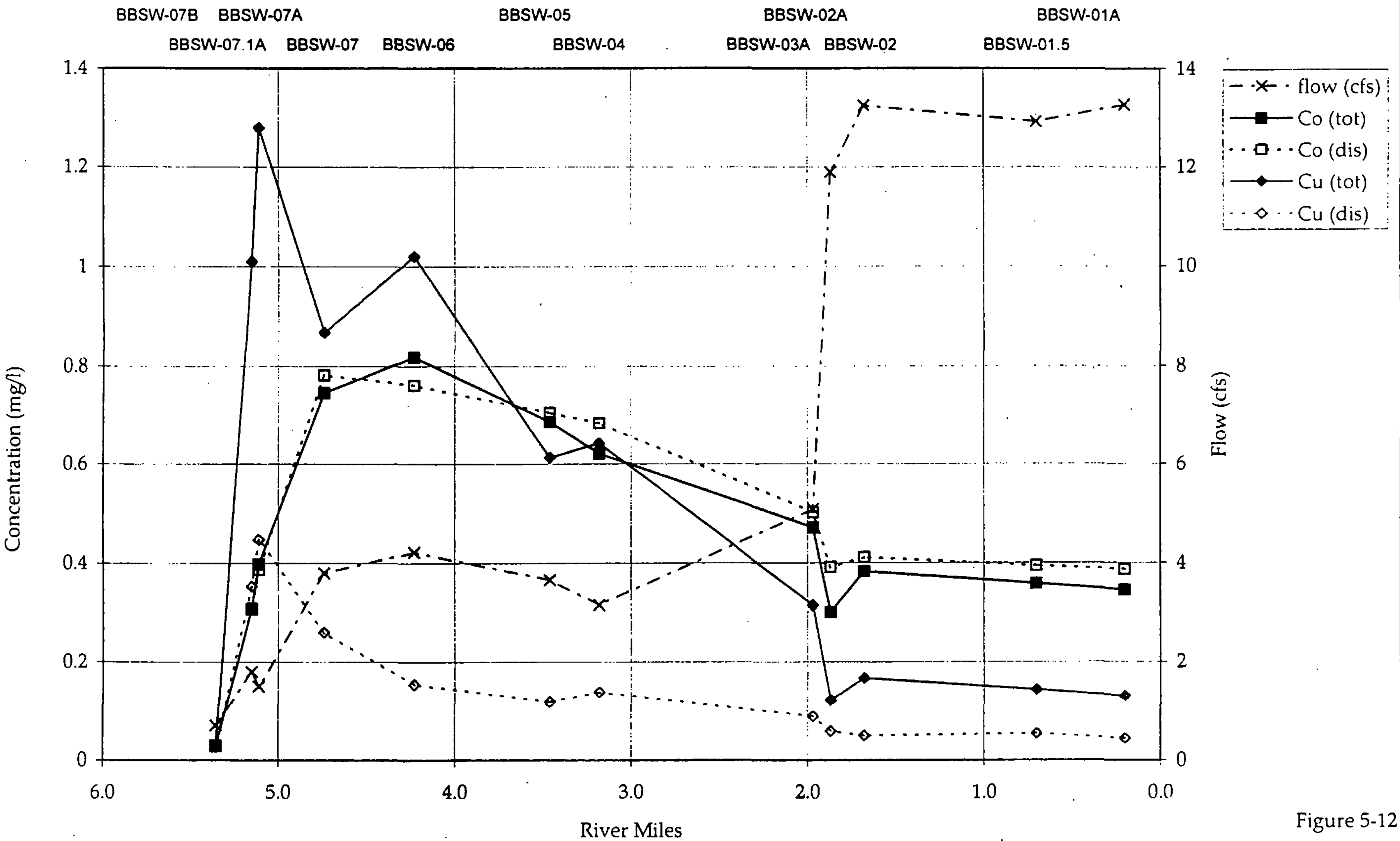


Figure 5-12

BLACKBIRD CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION SPRING 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, SPRING_BBSYN_00.xls

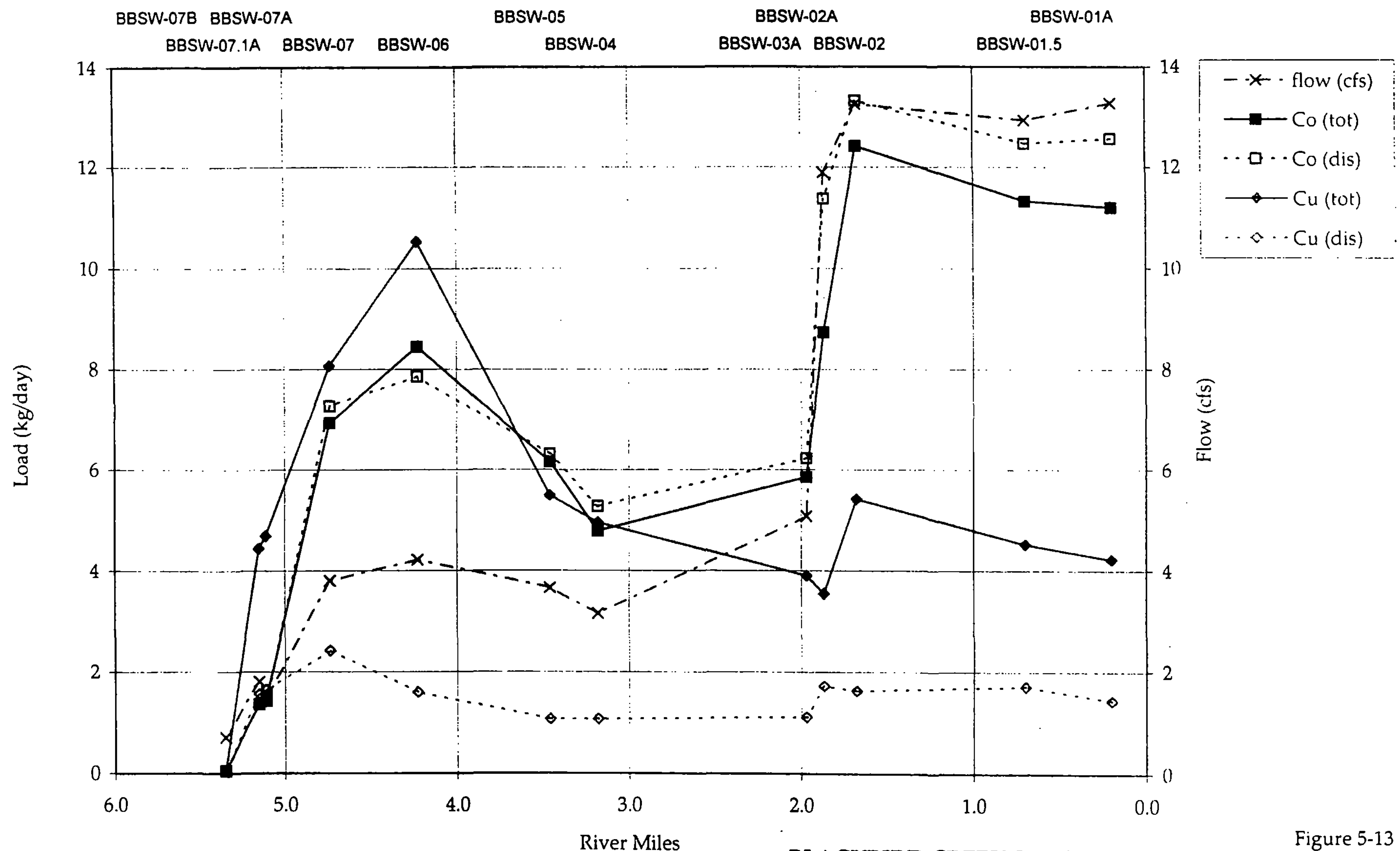


Figure 5-13
BLACKBIRD CREEK SYNOPTIC COBALT AND COPPER LOADING SPRING 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, SPRING_BBSYN_00.xls

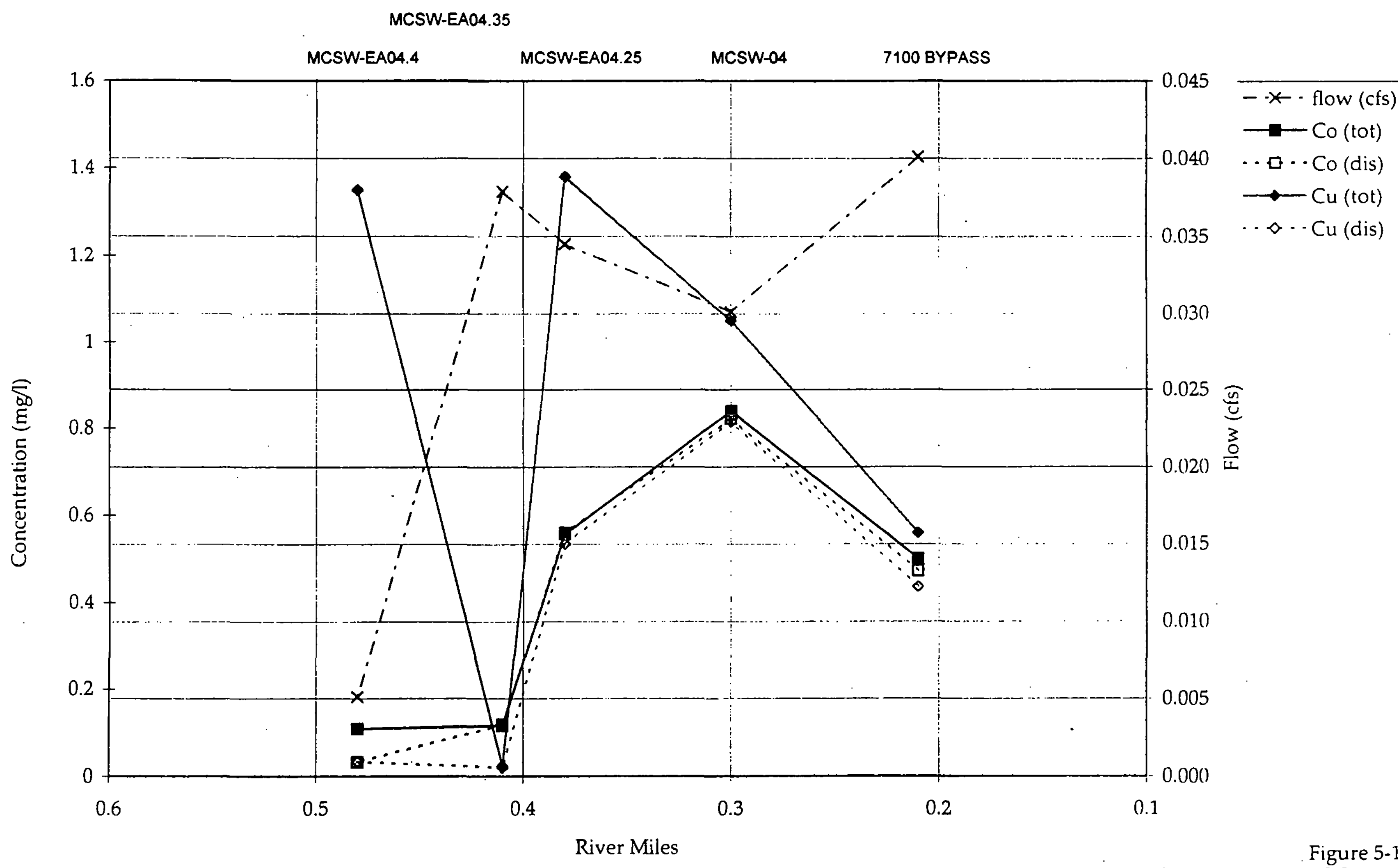


Figure 5-14
MEADOW CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION FALL 2000
BMSG/2000 DATA SUMMARY/ID
943-1595.003, 11/27/00, FALL_MCSYN_00.xls

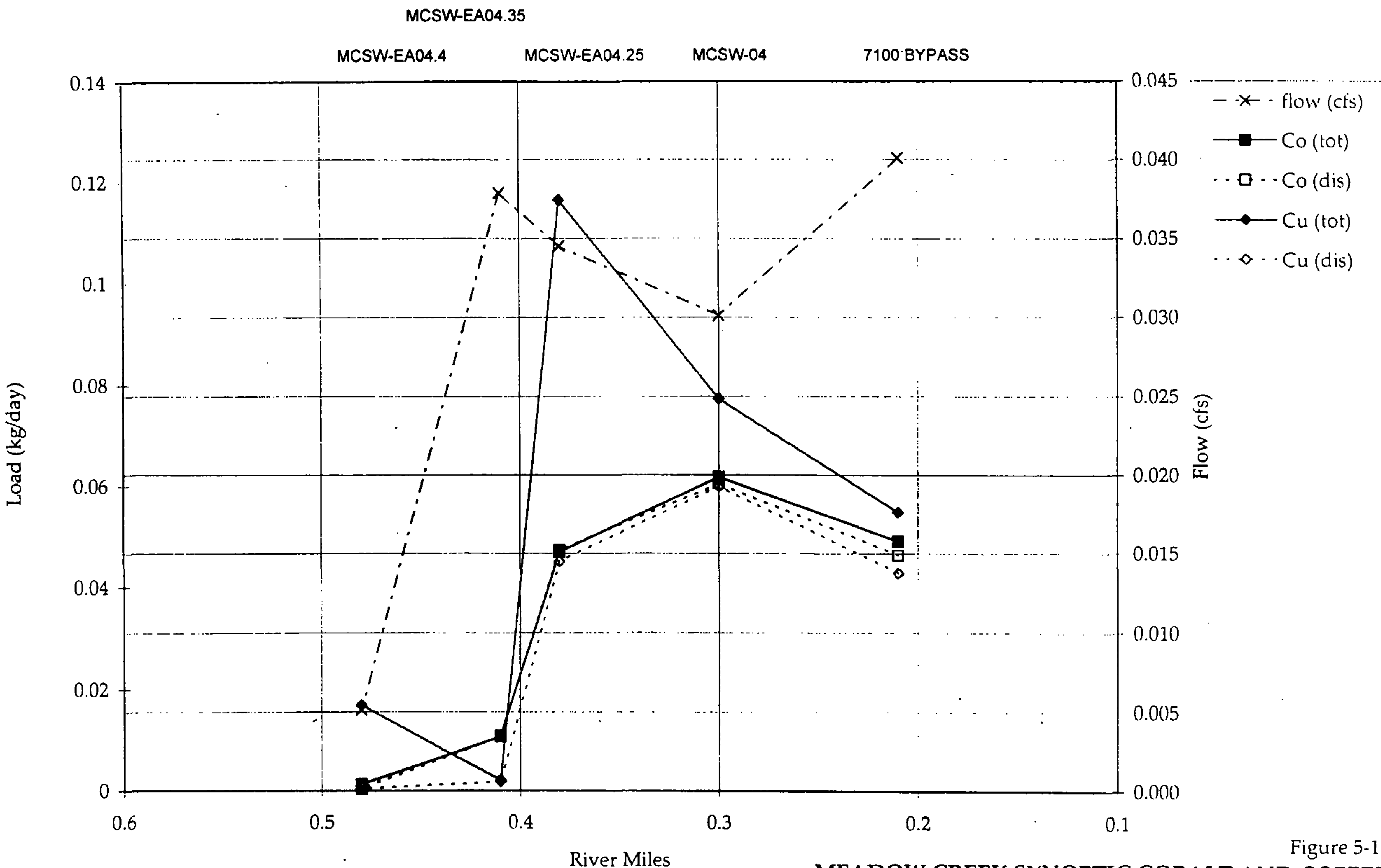


Figure 5-15

MEADOW CREEK SYNOPTIC COBALT AND COPPER LOADING FALL 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, FALL_MCSYN_00.xls

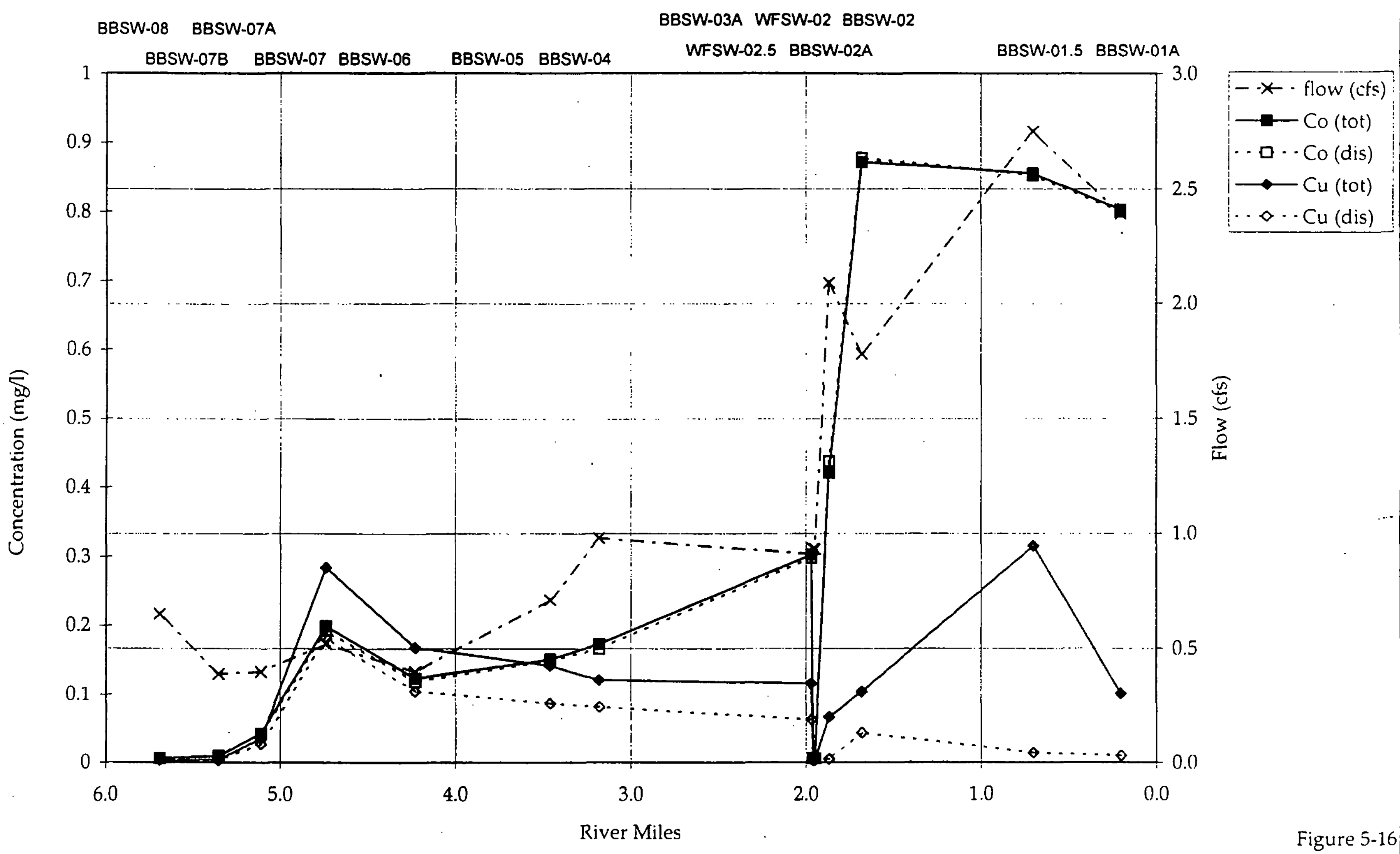


Figure 5-16

BLACKBIRD CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION FALL 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, FALL_BBSYN_00.xls

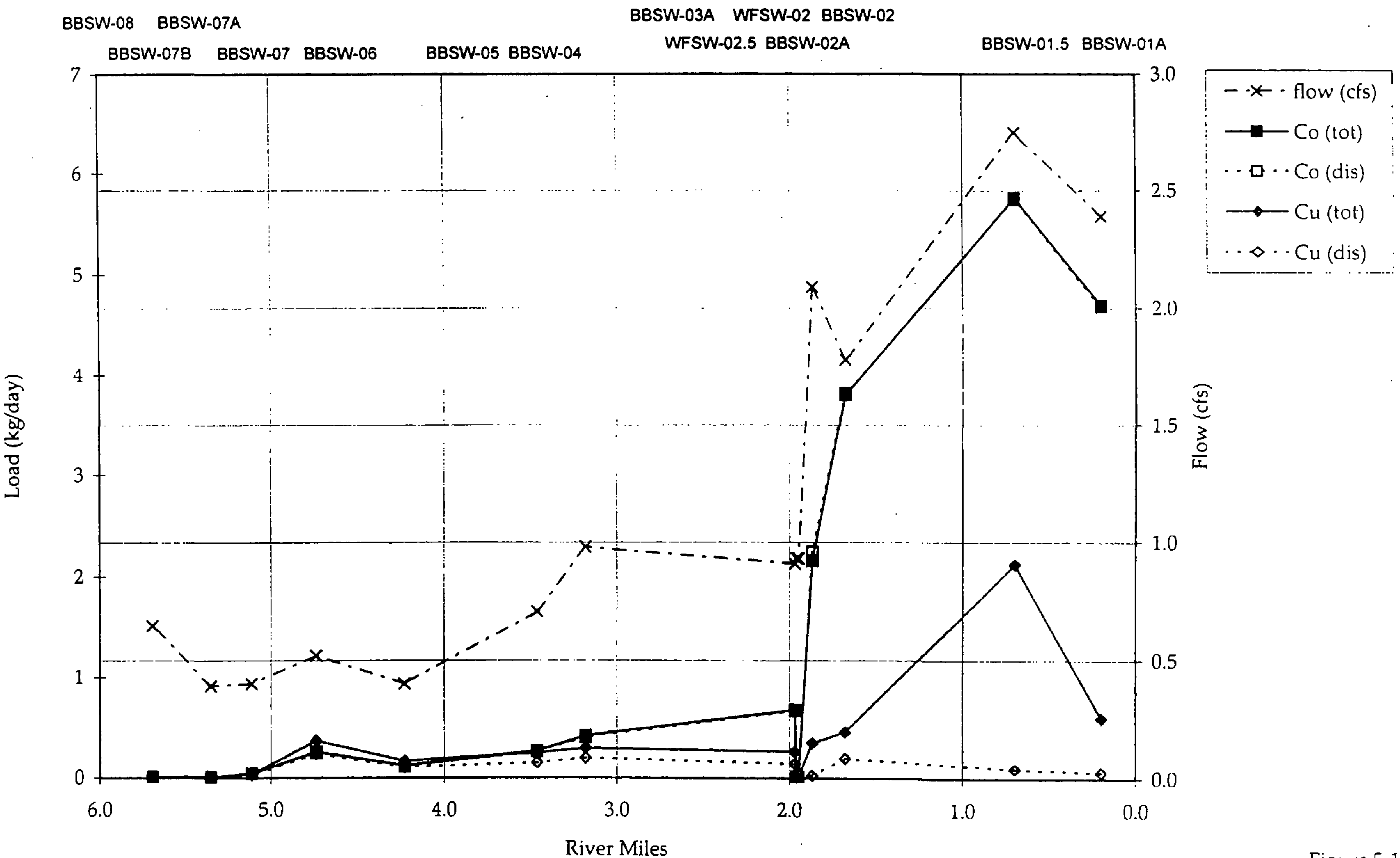


Figure 5-17

BLACKBIRD CREEK SYNOPTIC COBALT AND COPPER LOADING FALL 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, FALL_BBSYN_00.xls

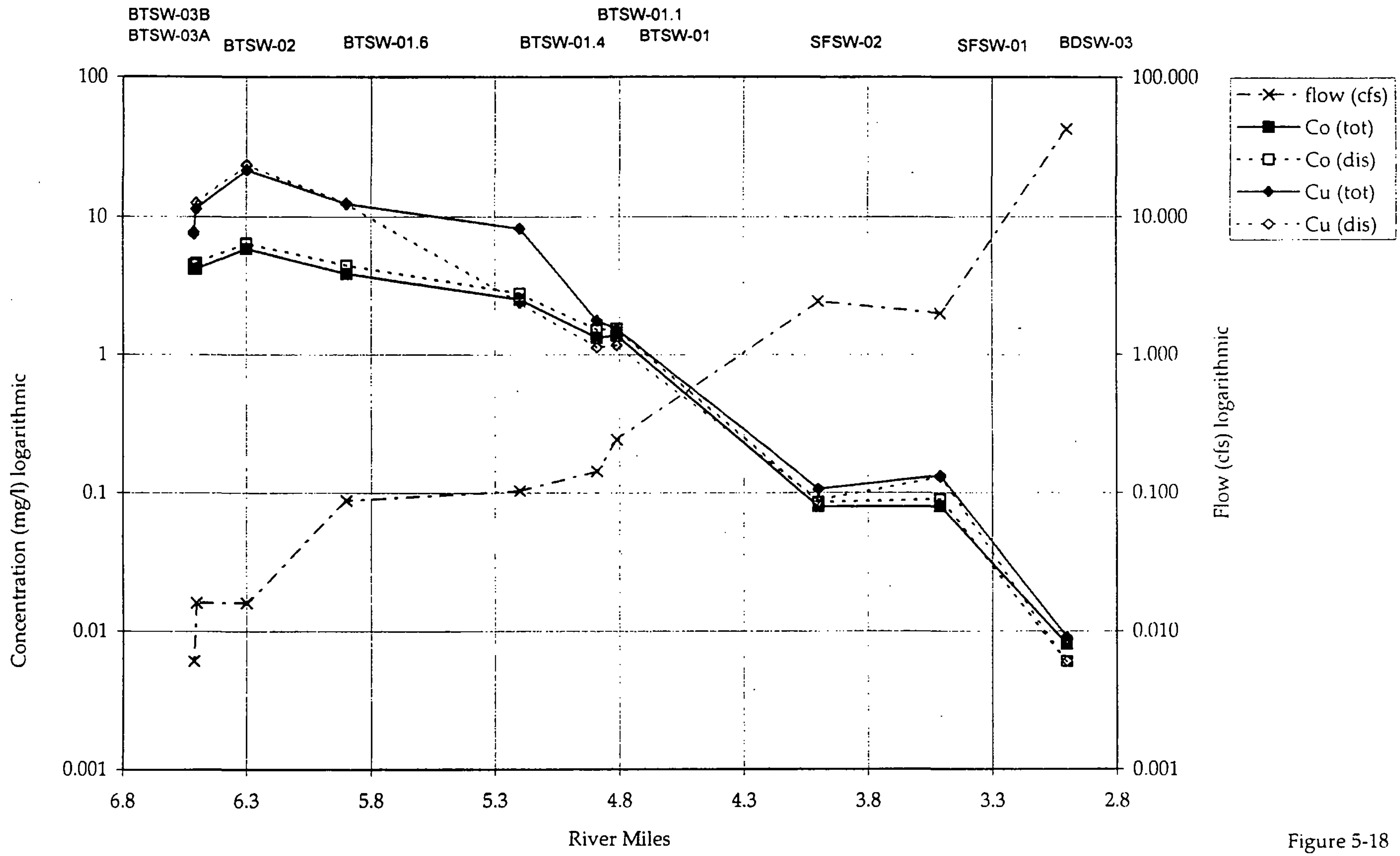


Figure 5-18
BUCKTAIL CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION SPRING 2000
BMSG/2000 DATA SUMMARY/ID
943-1595.003, 11/27/00, SPRING_BTSYN_00.xls

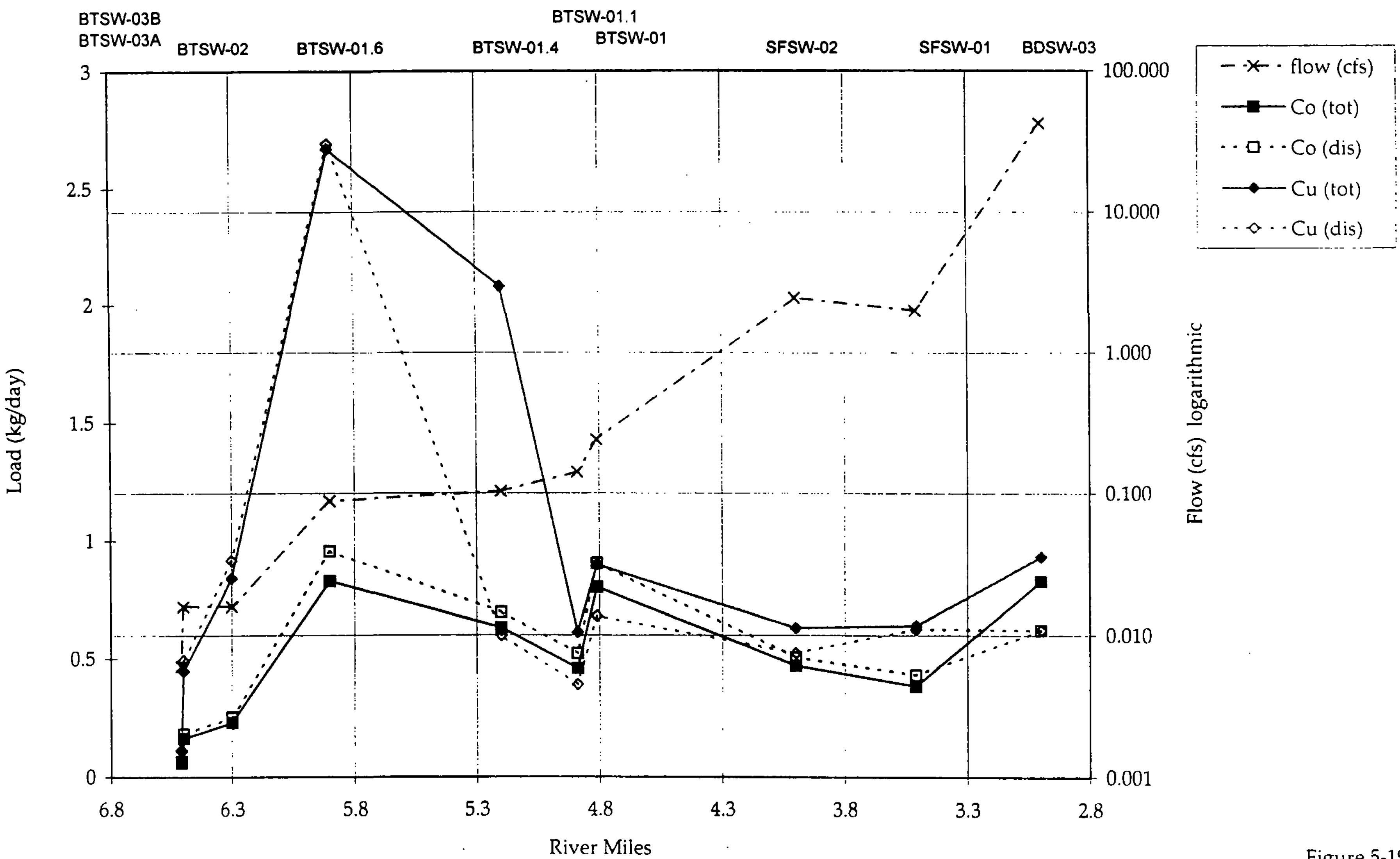


Figure 5-19
BUCKTAIL CREEK SYNOPTIC COBALT AND COPPER LOADING SPRING 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, SPRING_BTSYN_00.xls

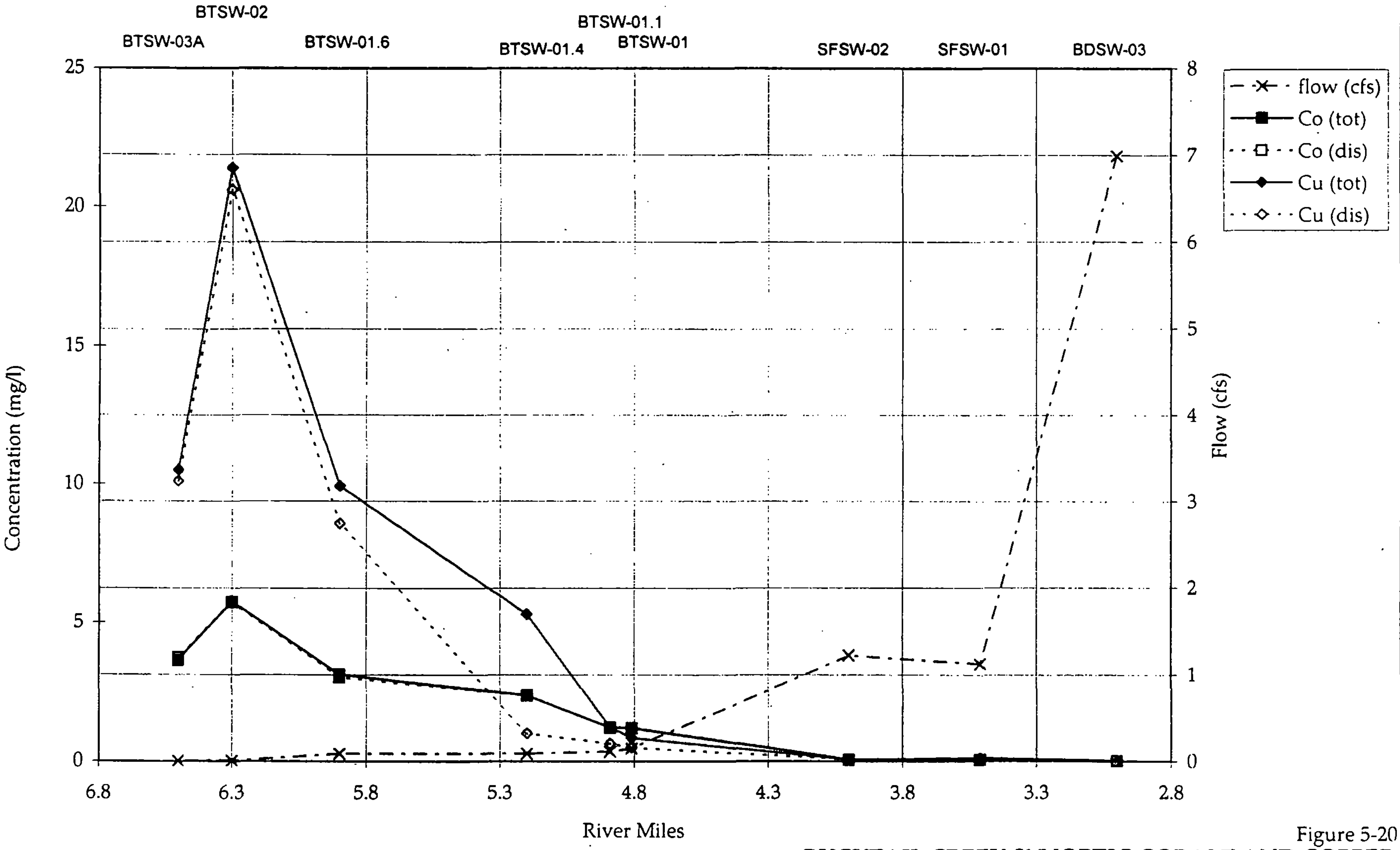


Figure 5-20
BUCKTAIL CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION FALL 2000
BMSG/2000 DATA SUMMARY/ID
943-1595.003, 11/27/00, FALL_BTSYN_00.xls

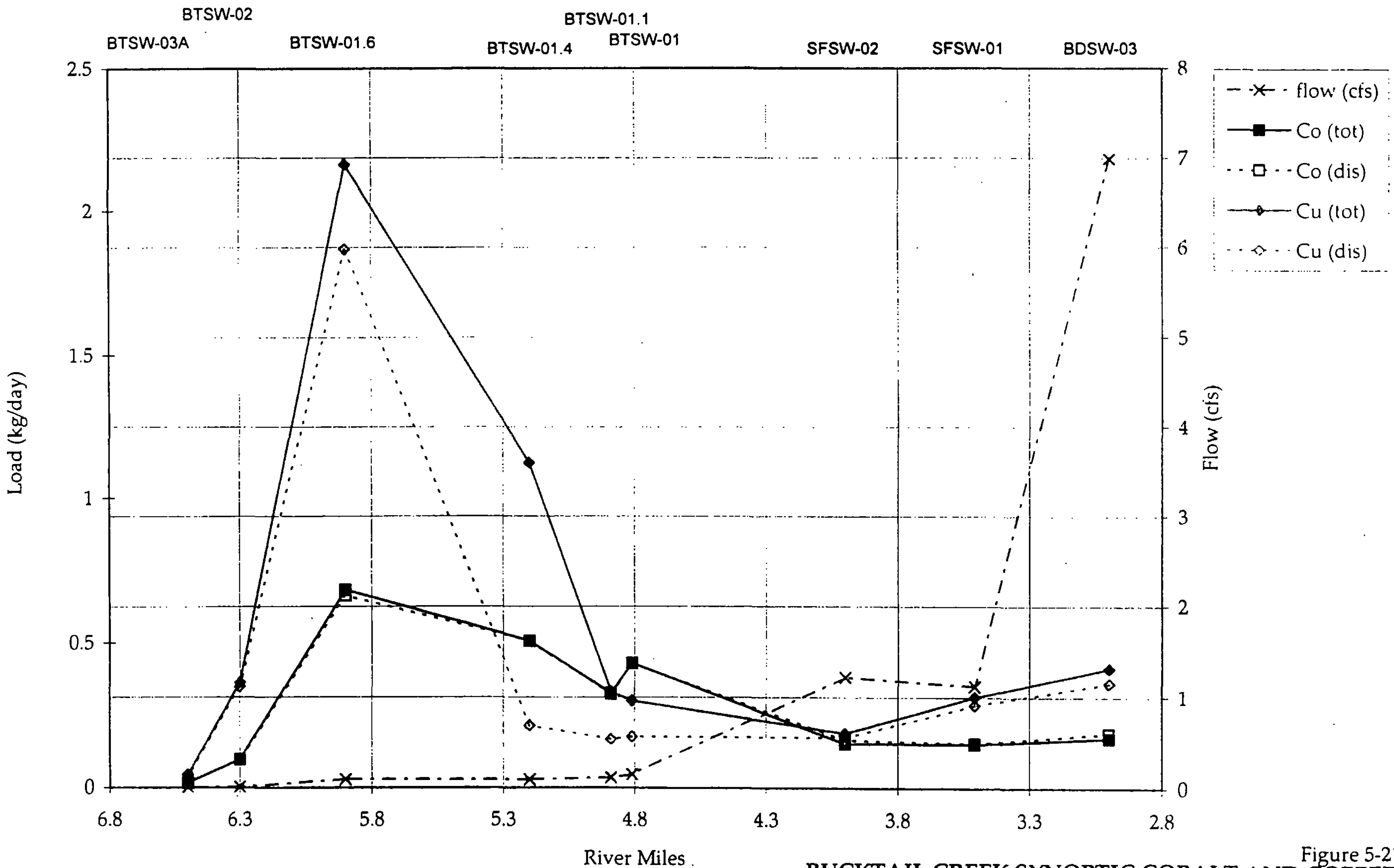


Figure 5-21
BUCKTAIL CREEK SYNOPTIC COBALT AND COPPER LOADING FALL 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, FALL_BTSYN_00.xls

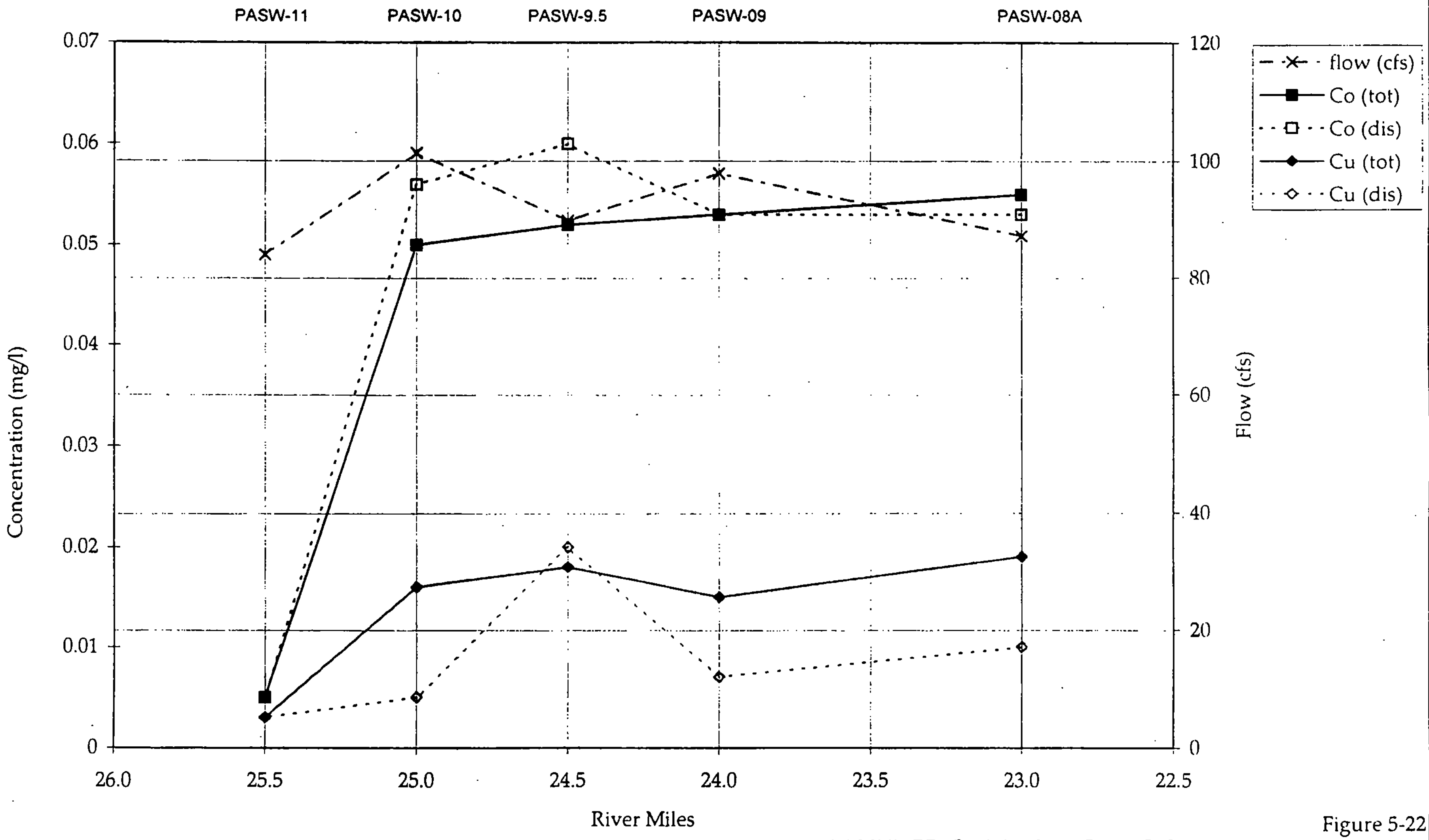


Figure 5-22
PANTHER CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION SPRING 2000
BMSG/2000 DATA SUMMARY/ID
943-1595.003, 11/27/00, SPRING_PCSYN_00.xls

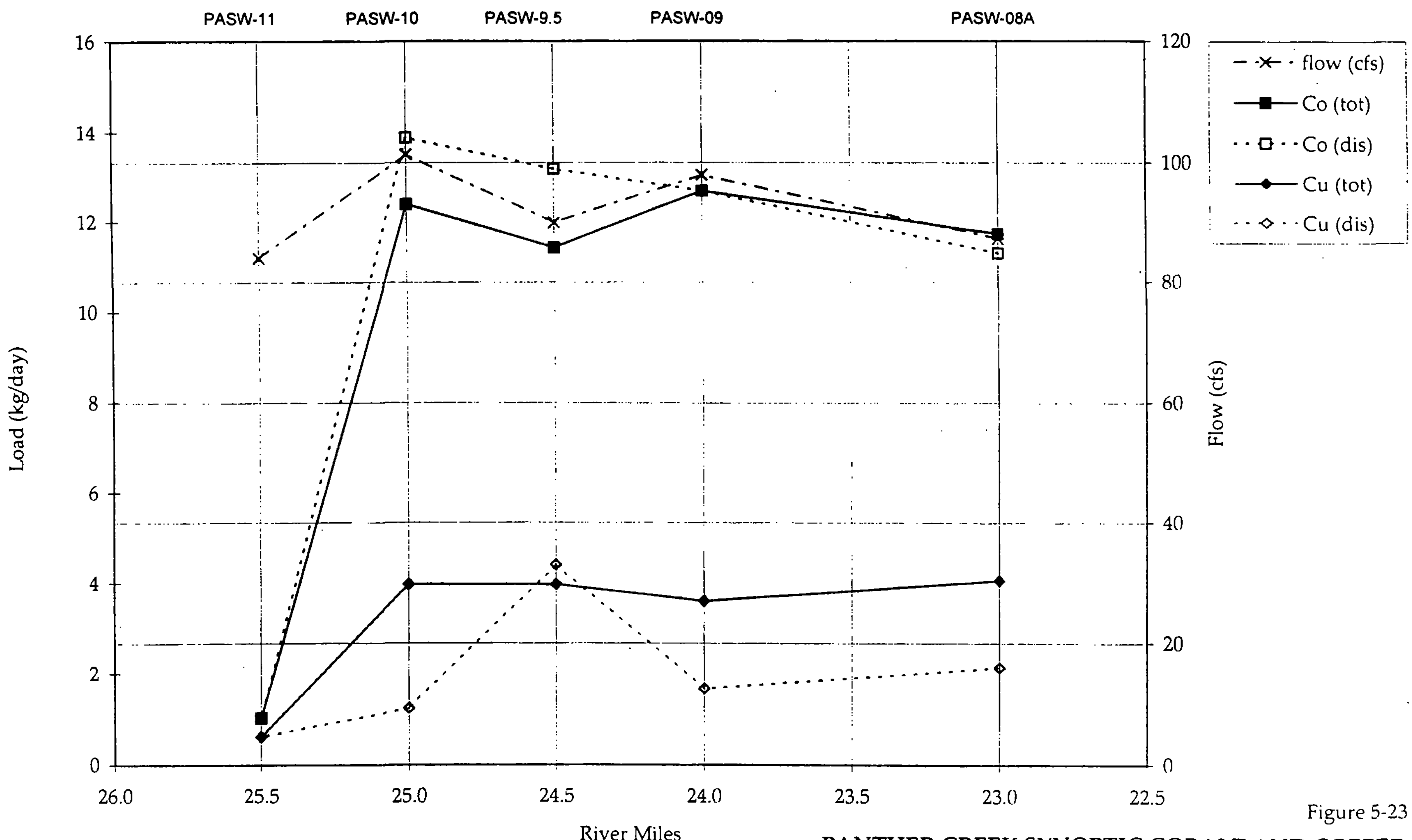


Figure 5-23

PANTHER CREEK SYNOPTIC COBALT AND COPPER LOADING SPRING 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, SPRING_PCSYN_00.xls

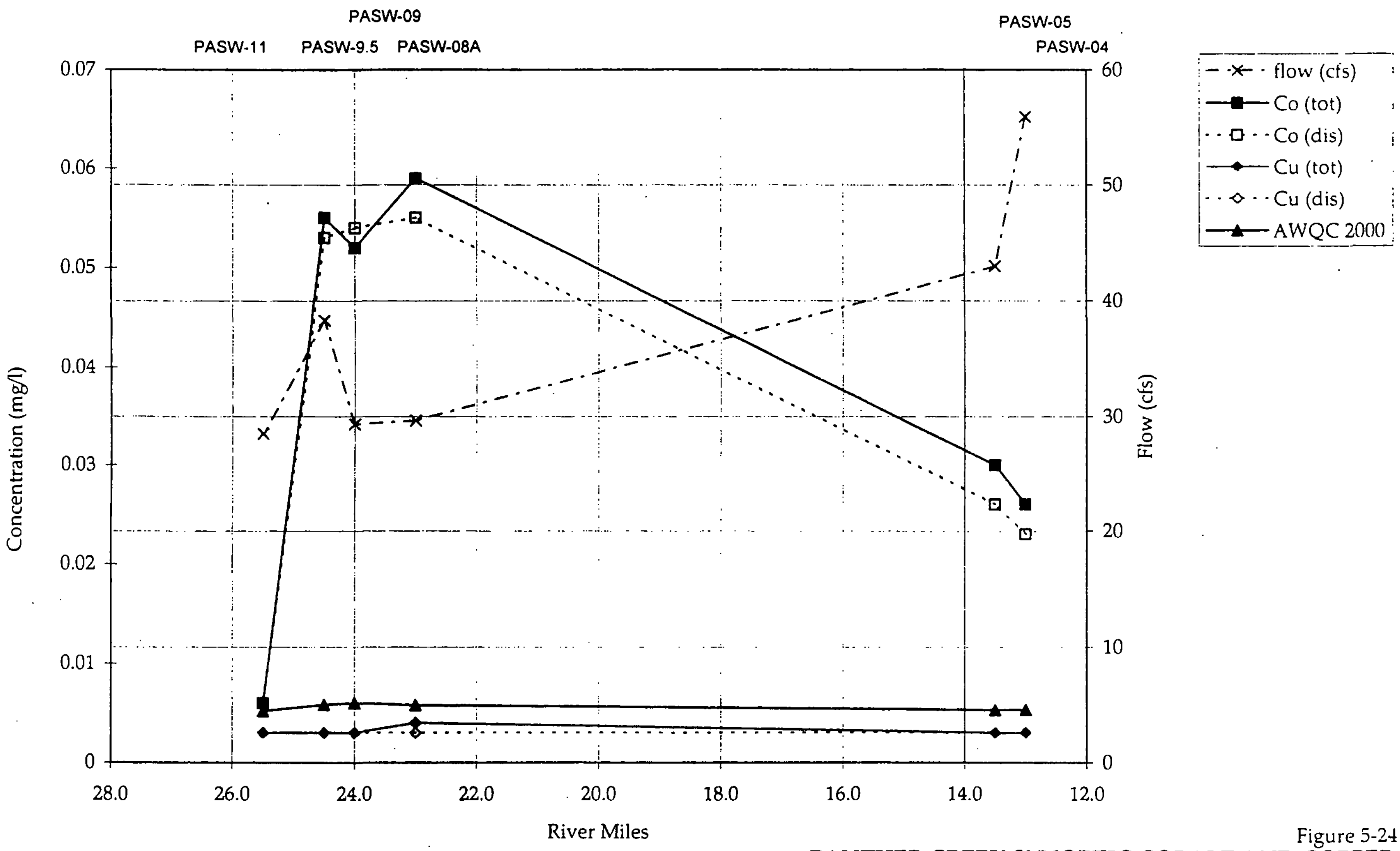


Figure 5-24
PANTHER CREEK SYNOPTIC COBALT AND COPPER CONCENTRATION FALL 2000
BMSG/2000 DATA SUMMARY/ID
943-1595.003, 11/27/00, FALL_PCSYN_00.xls

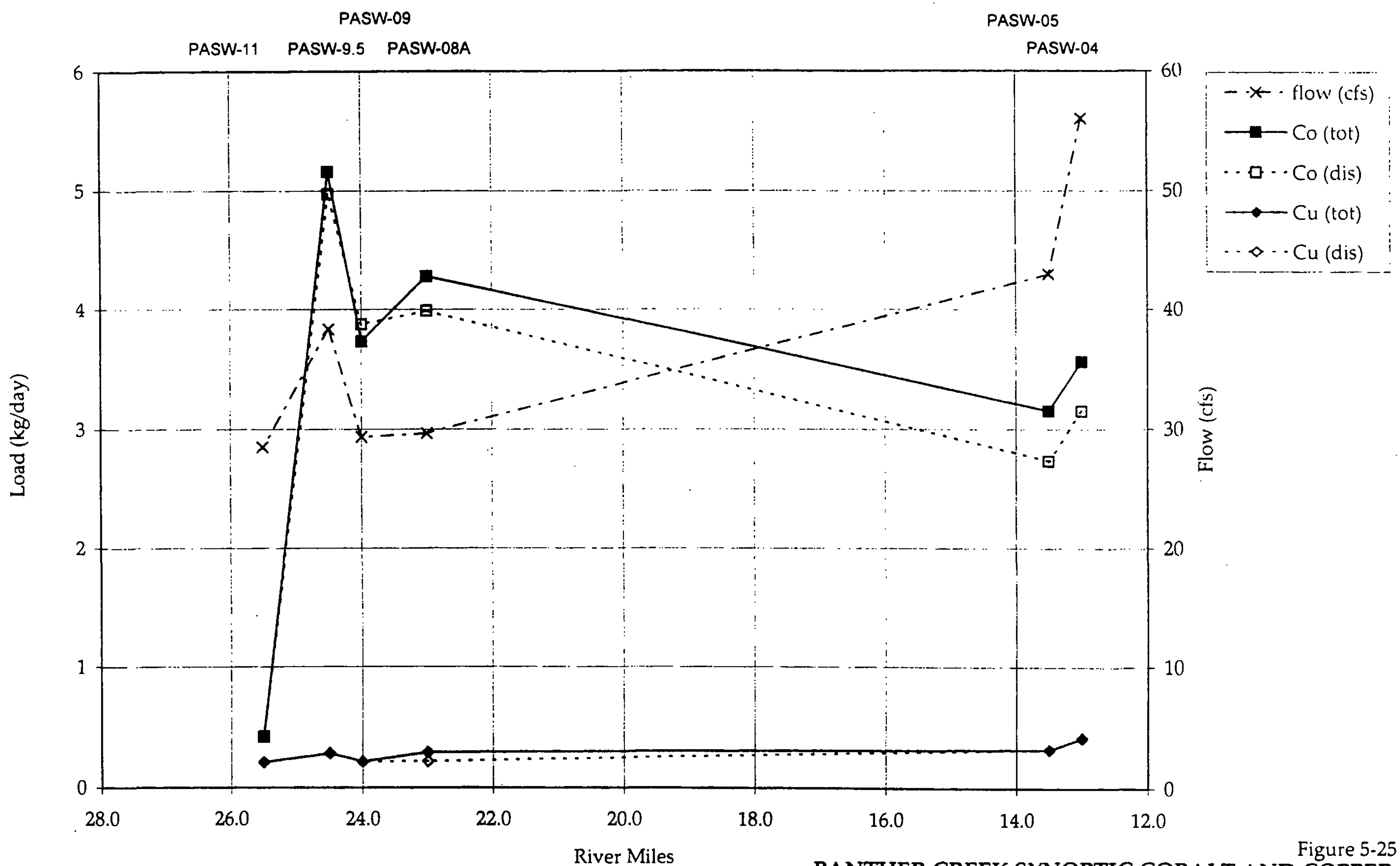


Figure 5-25
PANTHER CREEK SYNOPTIC COBALT AND COPPER LOADING FALL 2000

BMSG/2000 DATA SUMMARY/ID

943-1595.003, 11/27/00, FALL_PCSYN_00.xls

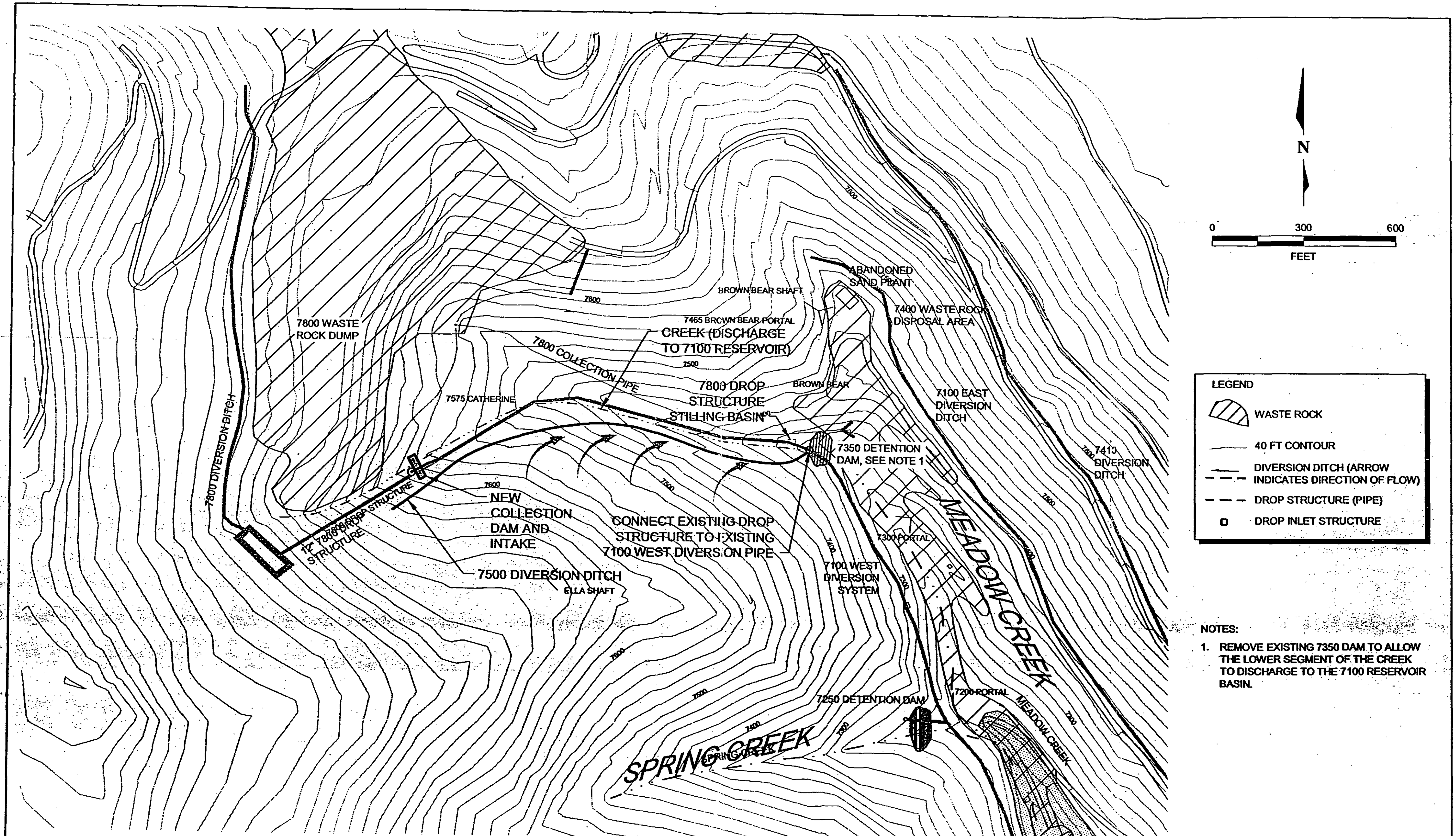


FIGURE **9-1**
MEADOW CREEK SEEP COLLECTION-CLEANWATER DIVERSION OPTION
FEASIBILITY STUDY/BLACKBIRD MINE SITE/ID

Drawing file: 94315950040500FD7.dwg Dec 16, 2002 - 4:12pm

Golder Associates

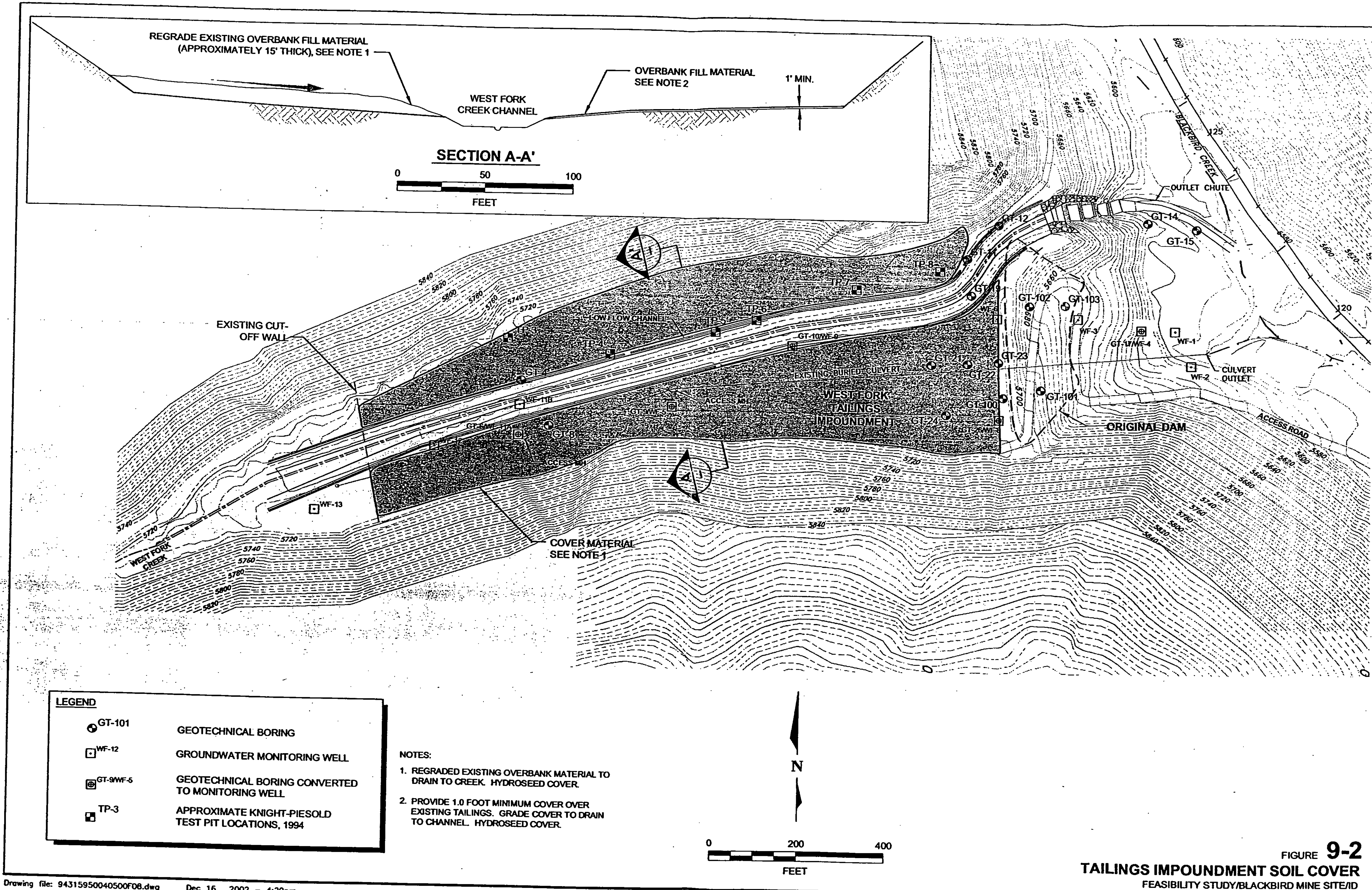


FIGURE 9-2
TAILINGS IMPOUNDMENT SOIL COVER
FEASIBILITY STUDY/BLACKBIRD MINE SITE/ID

Drawing file: 94315950040500F08.dwg Dec 16, 2002 - 4:20pm

Golder Associates

Proj\152238\ROD FILES\FINAL ROD FIGURES\FIG9-3.FH10 16-DEC-2002

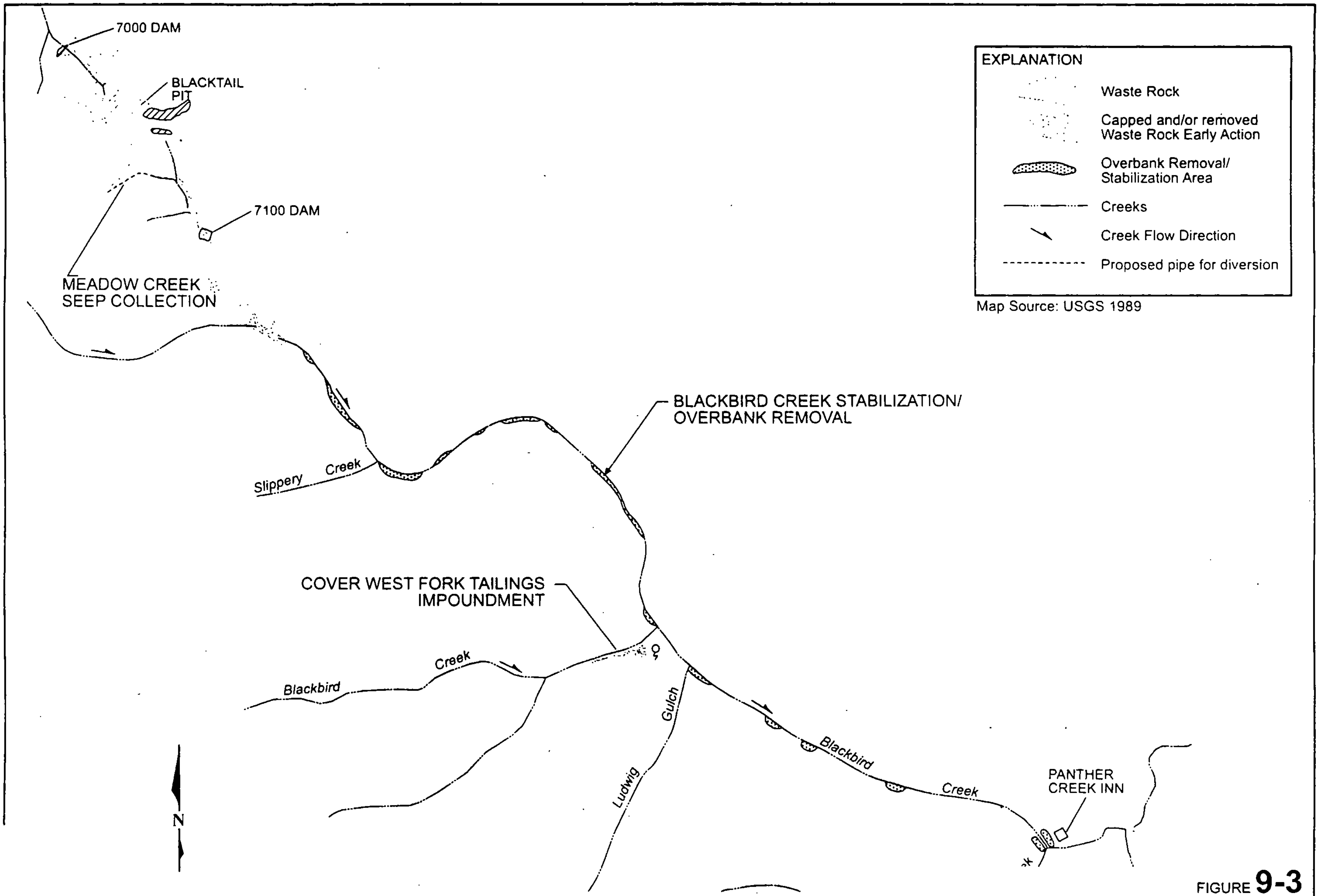


FIGURE **9-3**

PROPOSED ACTIONS – BLACKBIRD CREEK ALTERNATIVE BB-4

BMSG/BLACKBIRD MINE/ID

After Golder Associates

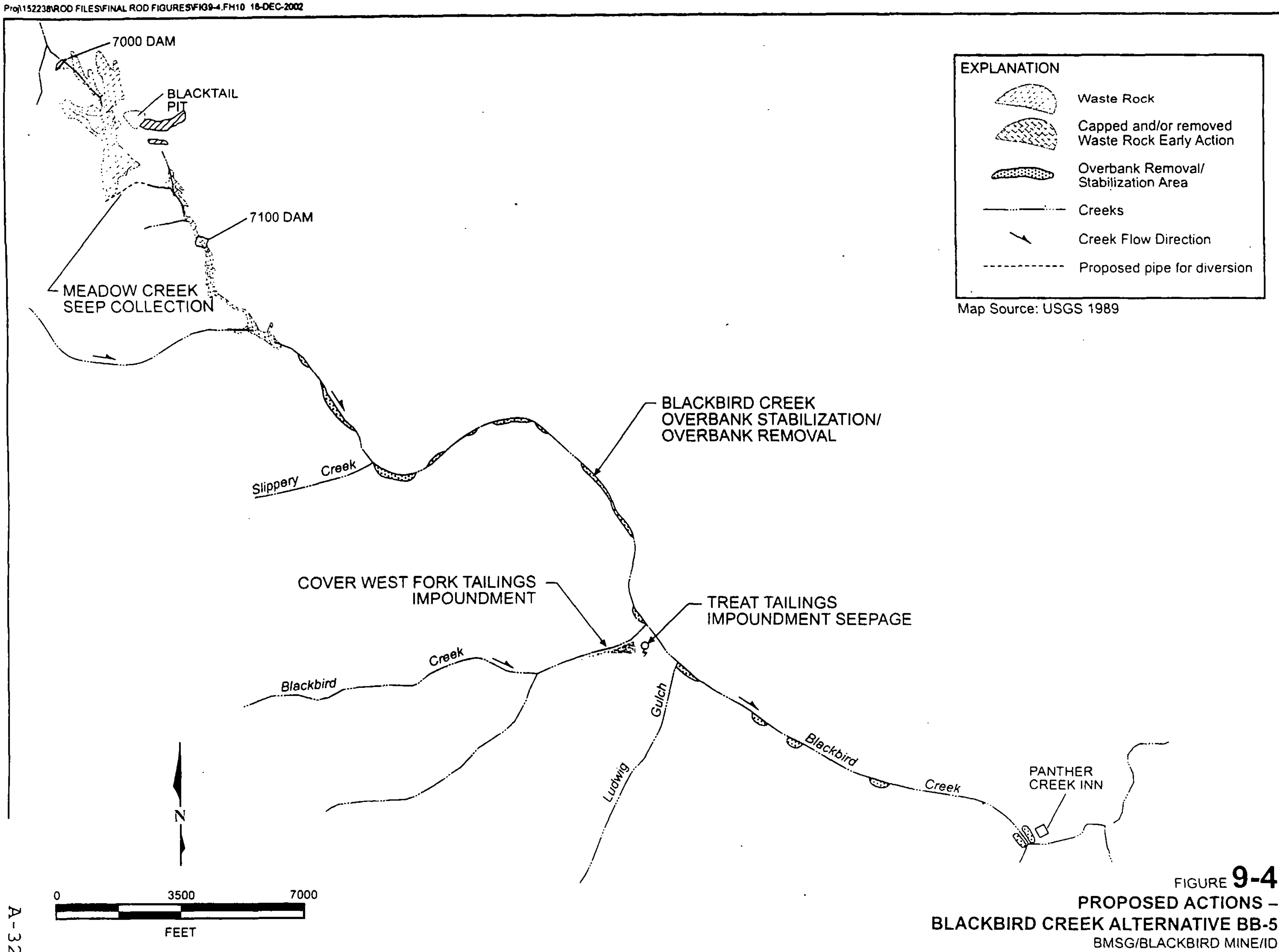


FIGURE **9-4**

PROPOSED ACTIONS – BLACKBIRD CREEK ALTERNATIVE BB-5

BMSG/BLACKBIRD MINE/ID

After Golder Associates

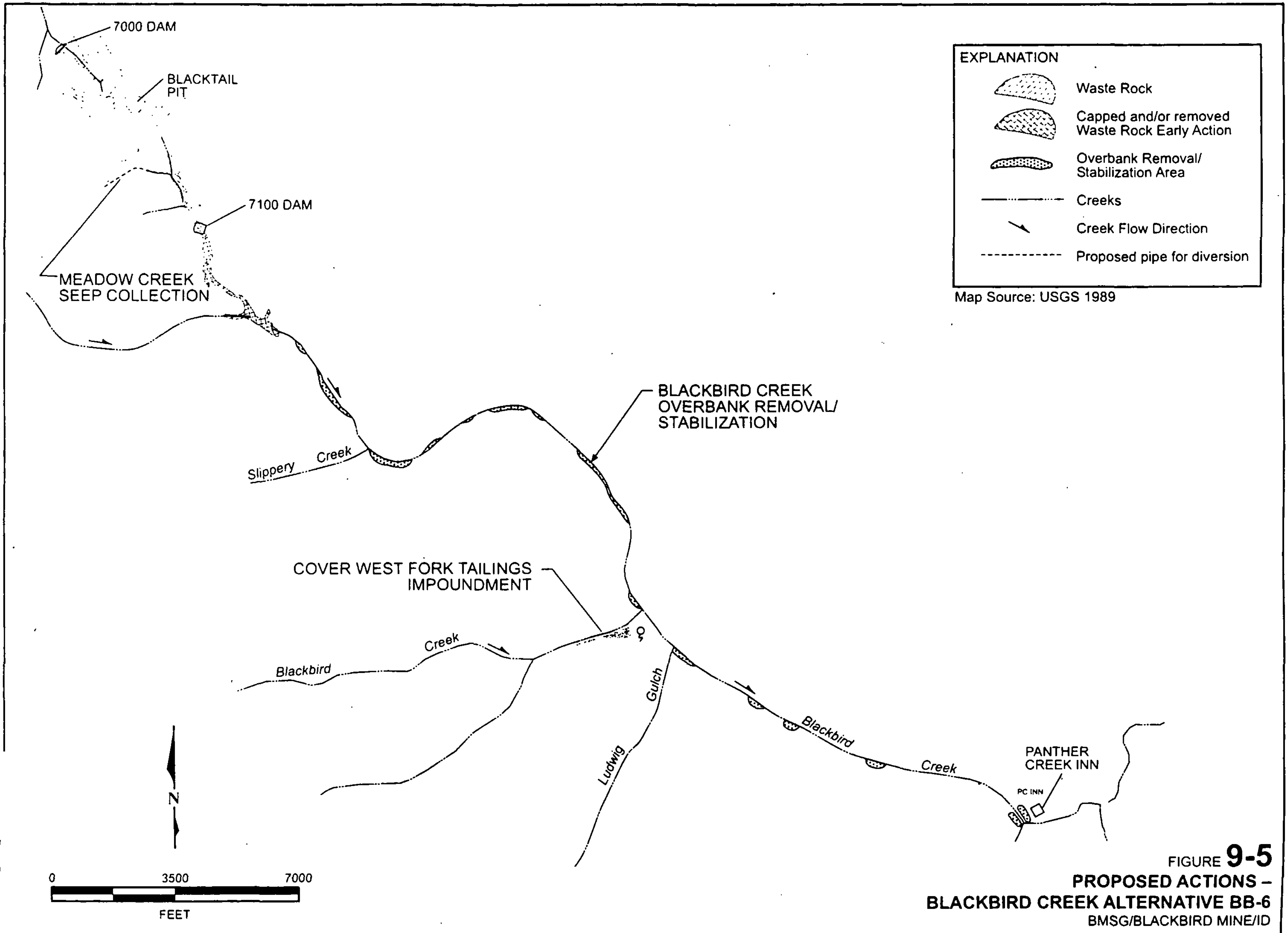


FIGURE **9-5**
PROPOSED ACTIONS – BLACKBIRD CREEK ALTERNATIVE BB-6
BMSG/BLACKBIRD MINE/ID

After Golder Associates

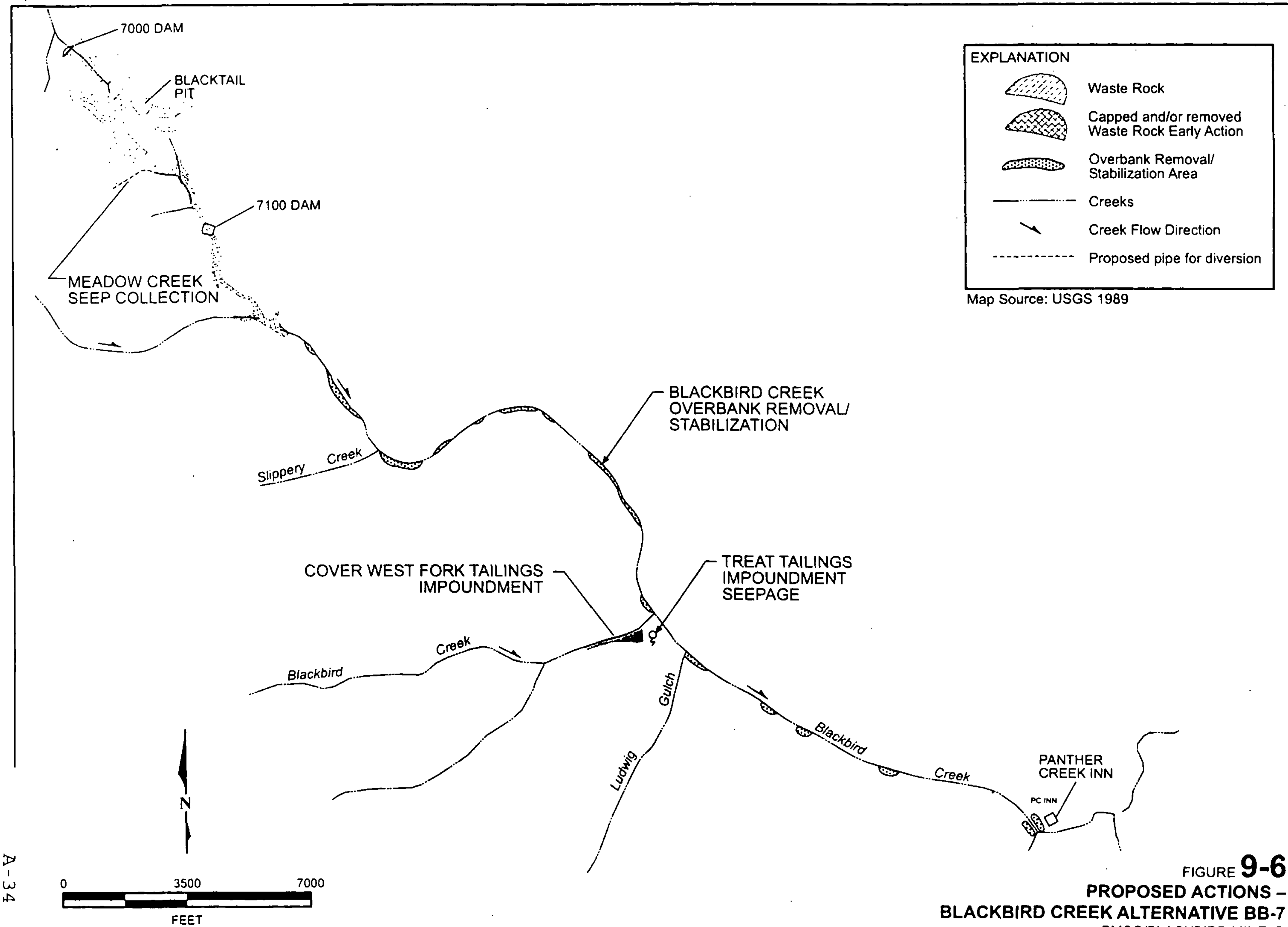


FIGURE **9-6**
PROPOSED ACTIONS – BLACKBIRD CREEK ALTERNATIVE BB-7
BMSG/BLACKBIRD MINE/ID

After Golder Associates

Proj\152238\ROD FILES\FINAL ROD FIGURES\FIG9-7.FH10 21-JAN-2003

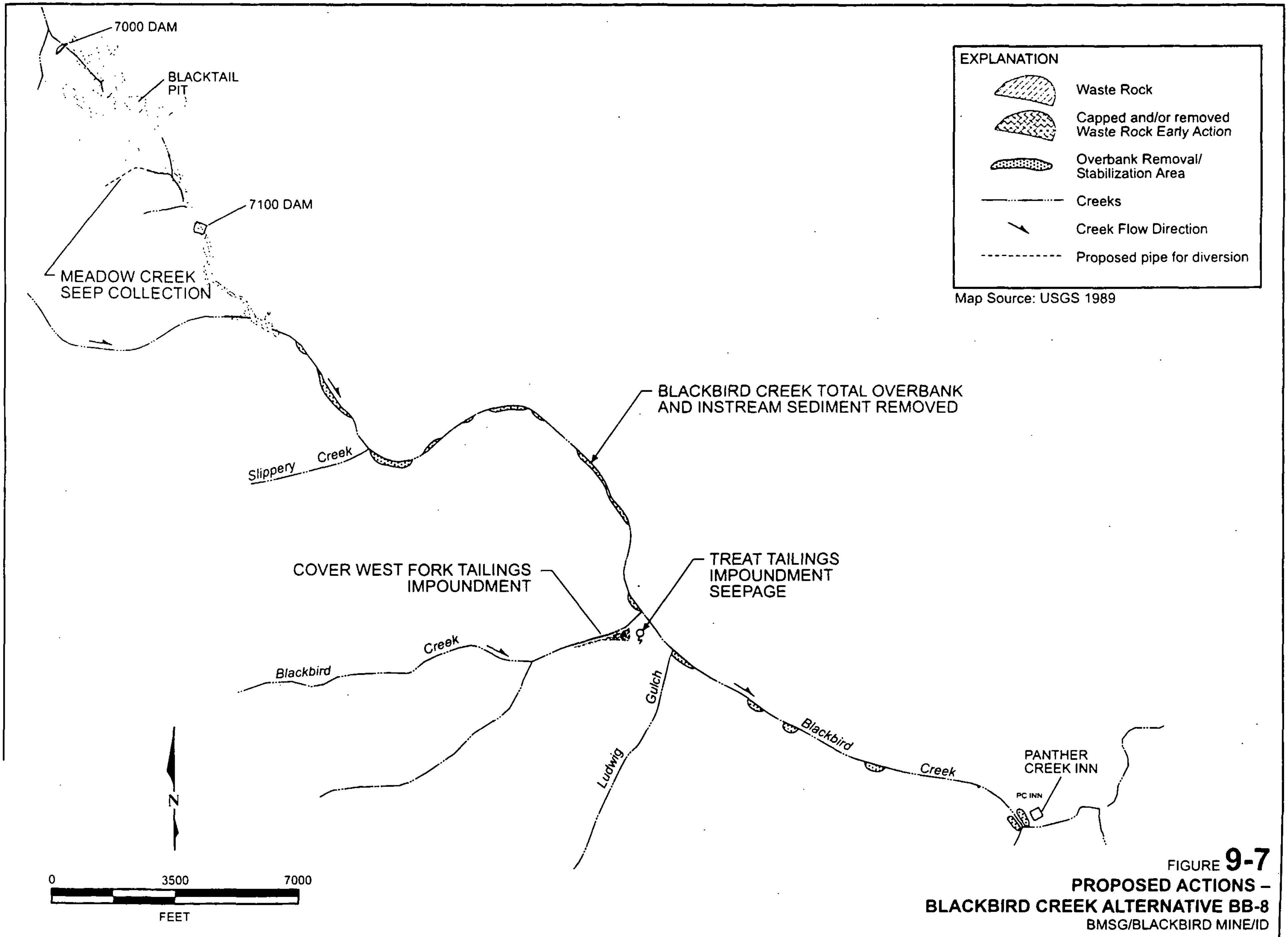
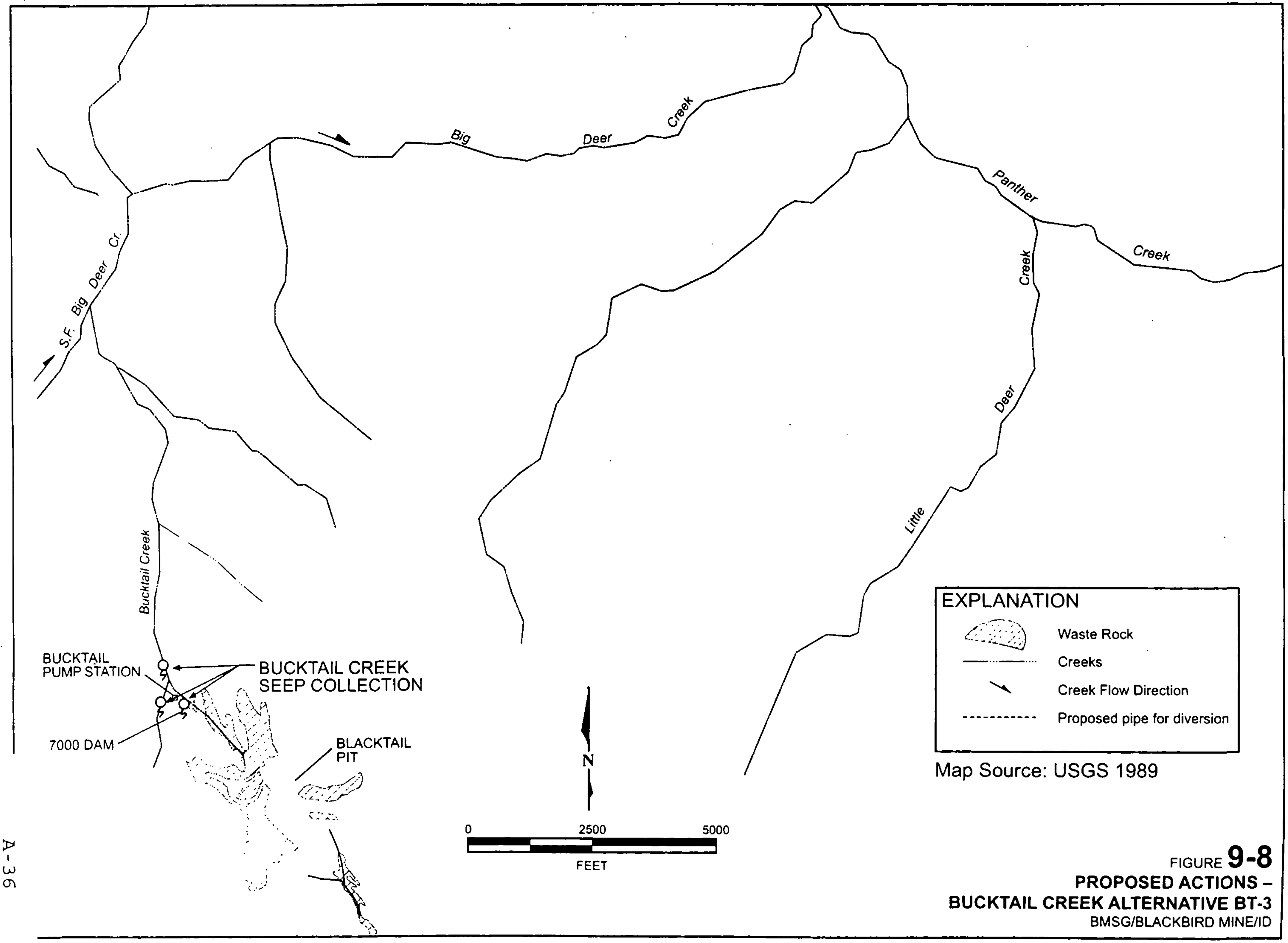


FIGURE **9-7**
PROPOSED ACTIONS –
BLACKBIRD CREEK ALTERNATIVE BB-8
BMSG/BLACKBIRD MINE/ID

After Golder Associates



Map Source: USGS 1989

FIGURE 9-8
PROPOSED ACTIONS – BUCKTAIL CREEK ALTERNATIVE BT-3
BMSG/BLACKBIRD MINE/ID

After Golder Associates

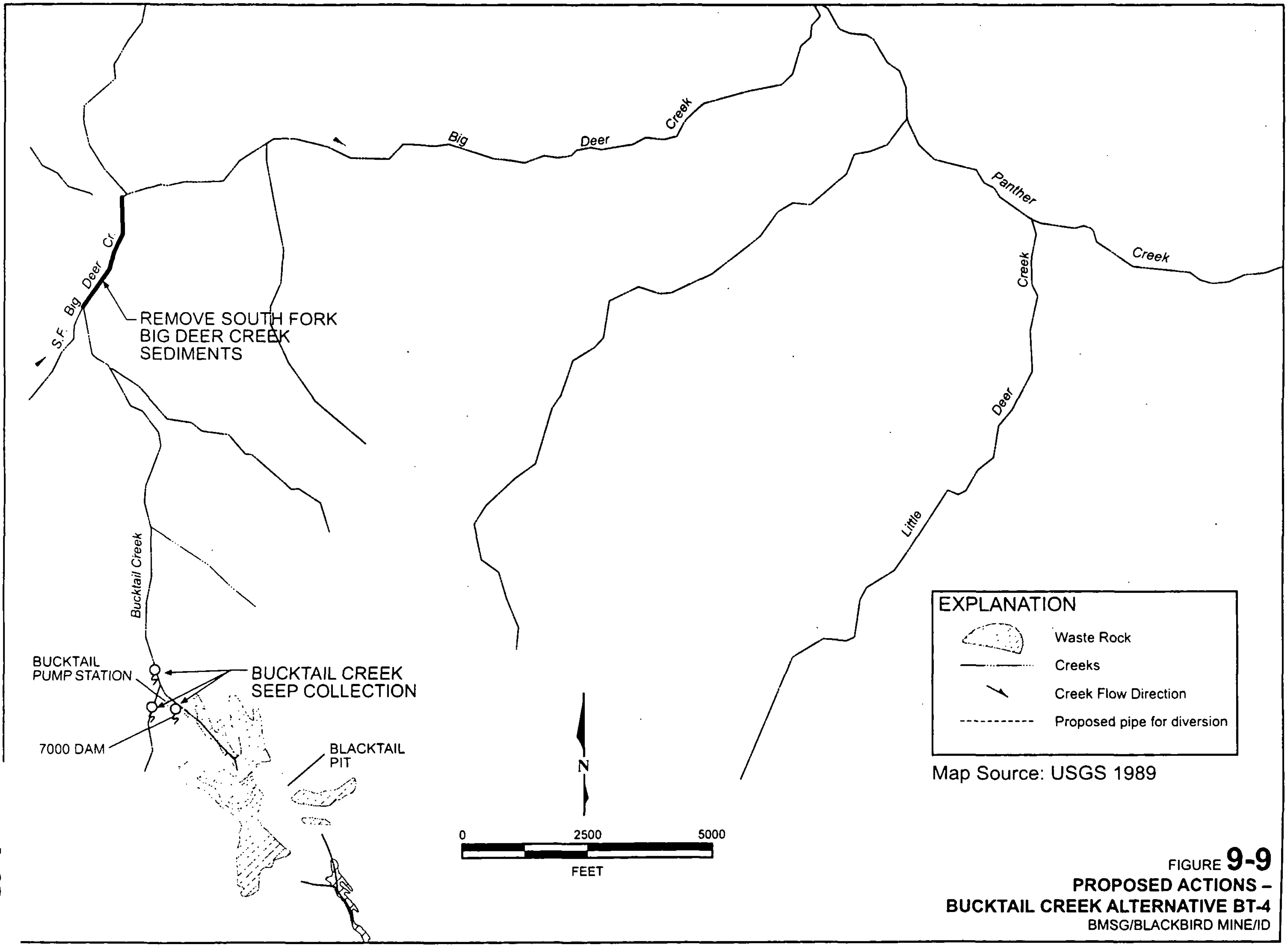


FIGURE **9-9**
PROPOSED ACTIONS – BUCKTAIL CREEK ALTERNATIVE BT-4
BMSG/BLACKBIRD MINE/ID

After Golder Associates

Proj\152238\ROD FILES\FINAL ROD FIGURES\FIG9-10 FH10 21-JAN-2003

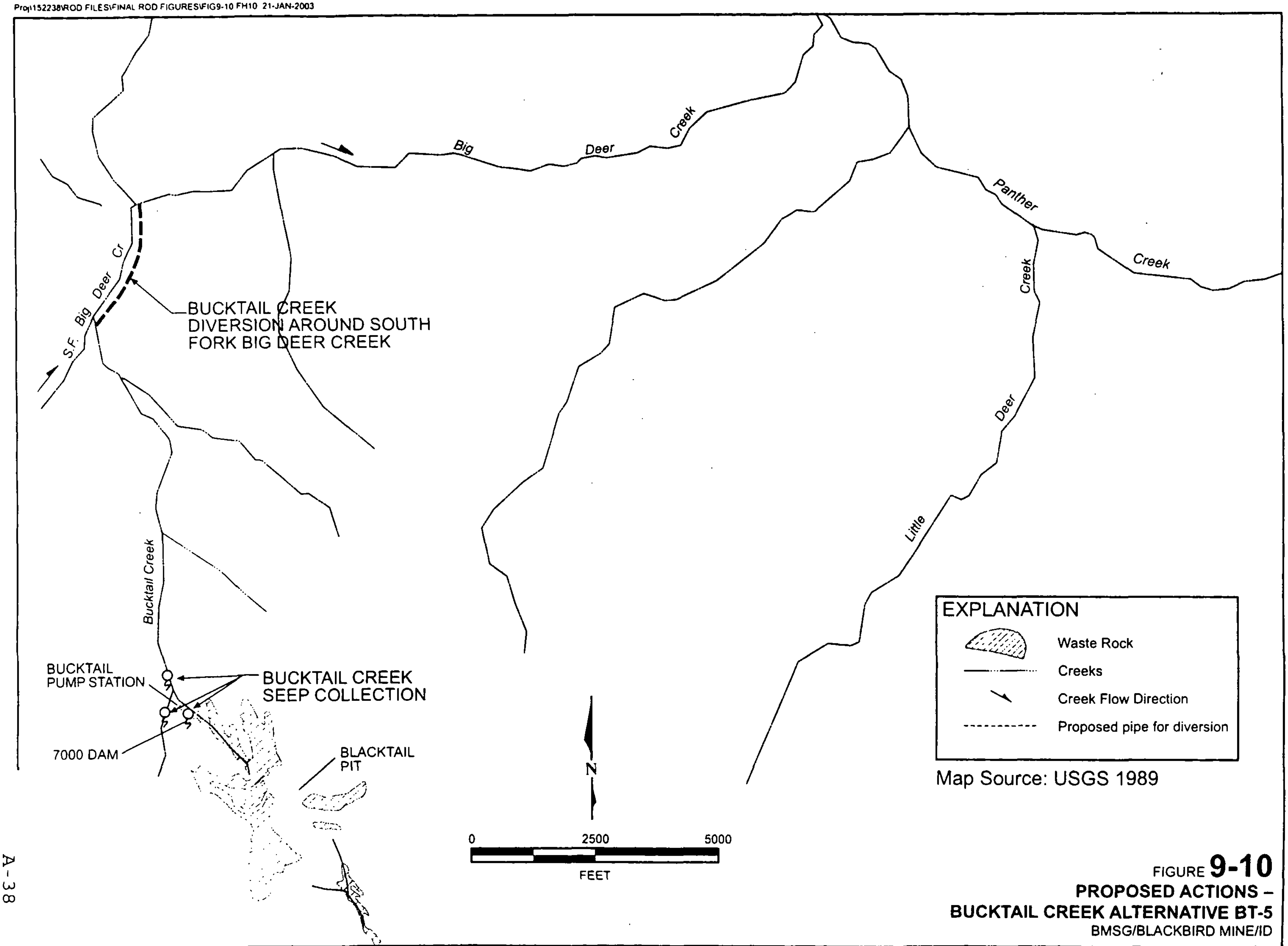
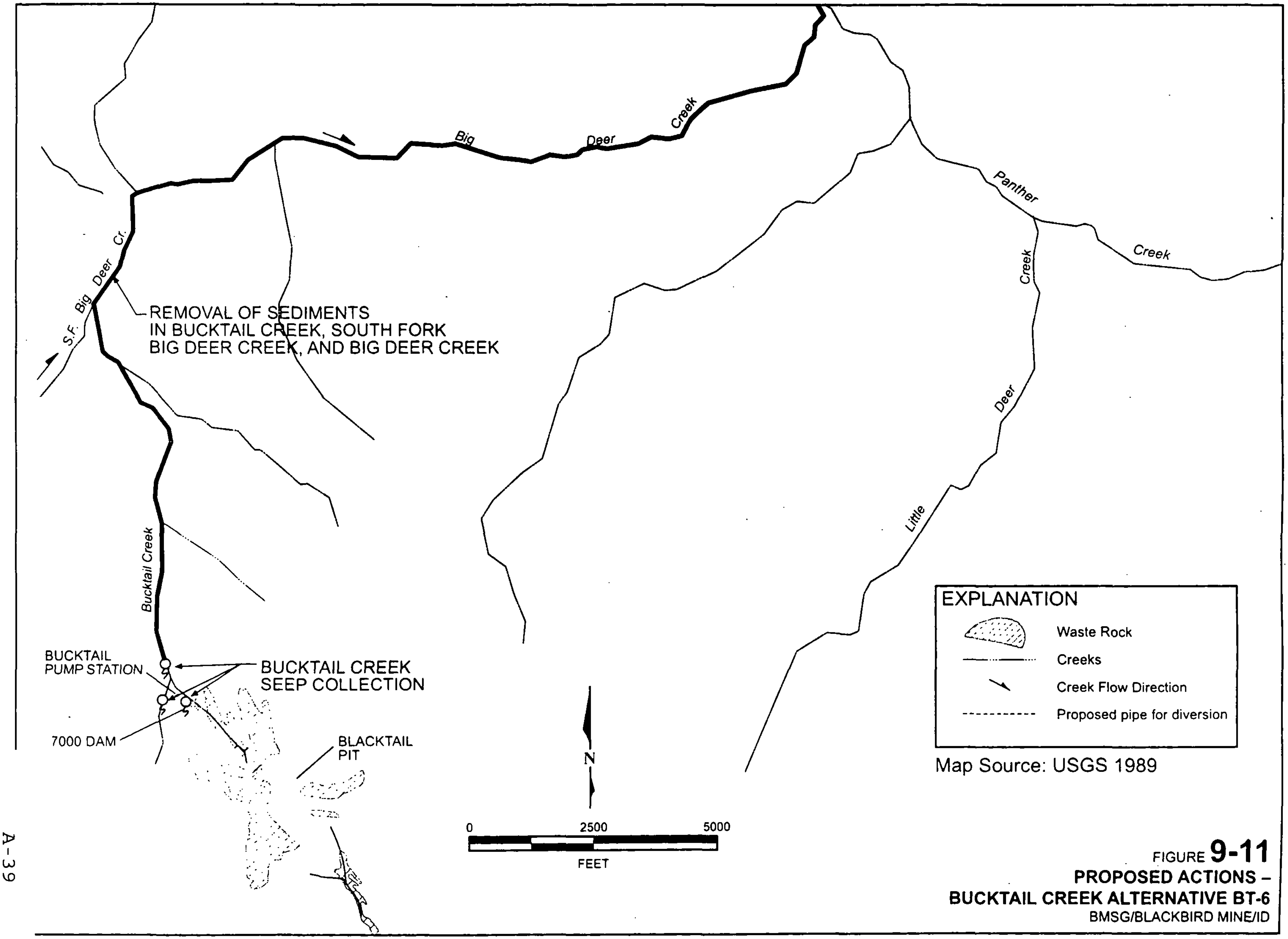


FIGURE **9-10**
PROPOSED ACTIONS – BUCKTAIL CREEK ALTERNATIVE BT-5
BMSG/BLACKBIRD MINE/ID

After Golder Associates

Proj\152238\ROD FILES\FINAL ROD FIGURES\FIG9-11 FH10 21-JAN-2003



Map Source: USGS 1989

FIGURE **9-11**
PROPOSED ACTIONS – BUCKTAIL CREEK ALTERNATIVE BT-6
BMSG/BLACKBIRD MINE/ID

After Golder Associates

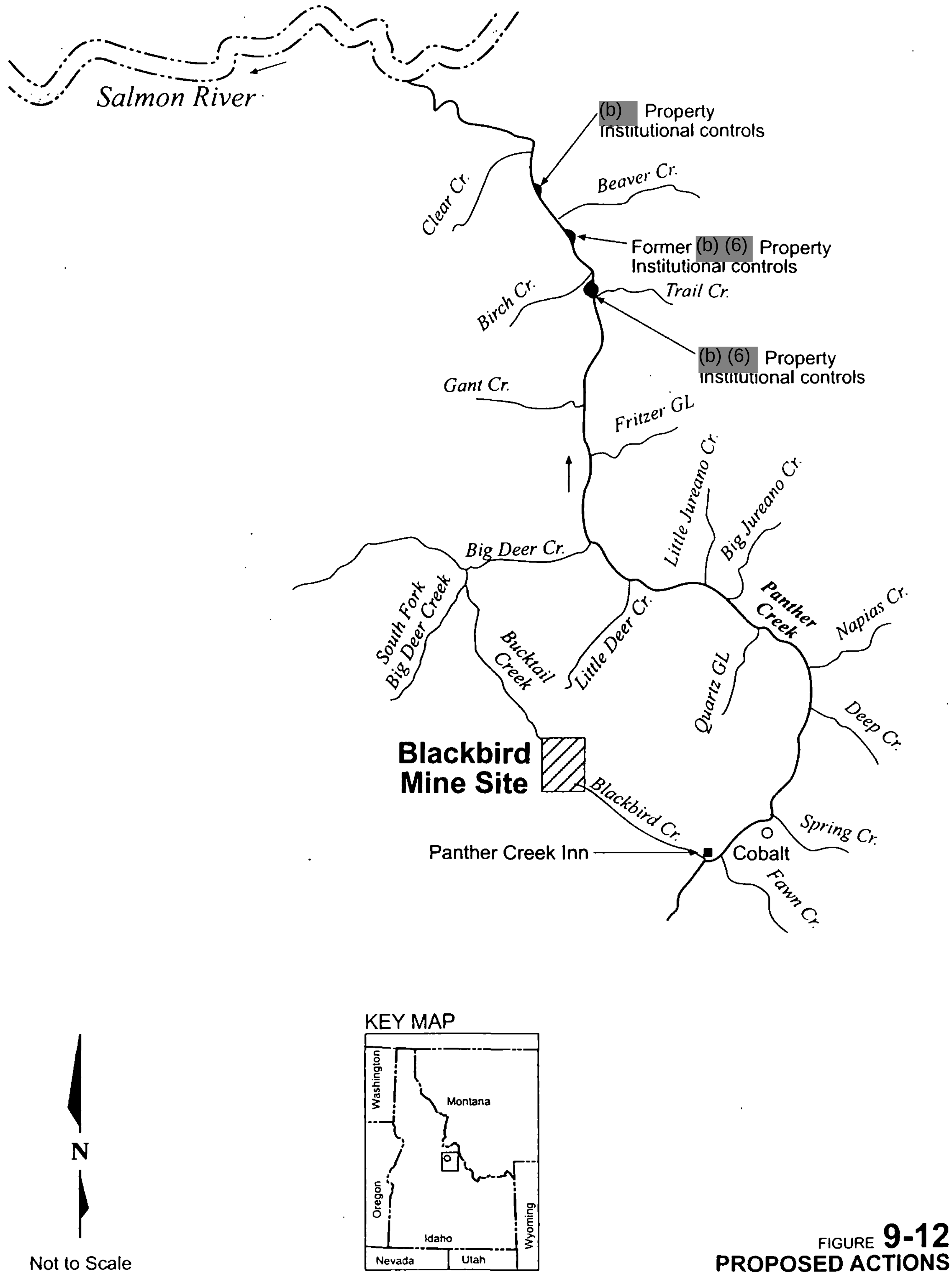


FIGURE **9-12**
PROPOSED ACTIONS
PANTHER CREEK ALTERNATIVE P-2
BMSG/BLACKBIRD MINE SITE/ID

proj\152238\ROD FILES\FINAL ROD FIGURES\FIG9-12.FH10 21-JAN-2003

After Golder Associates

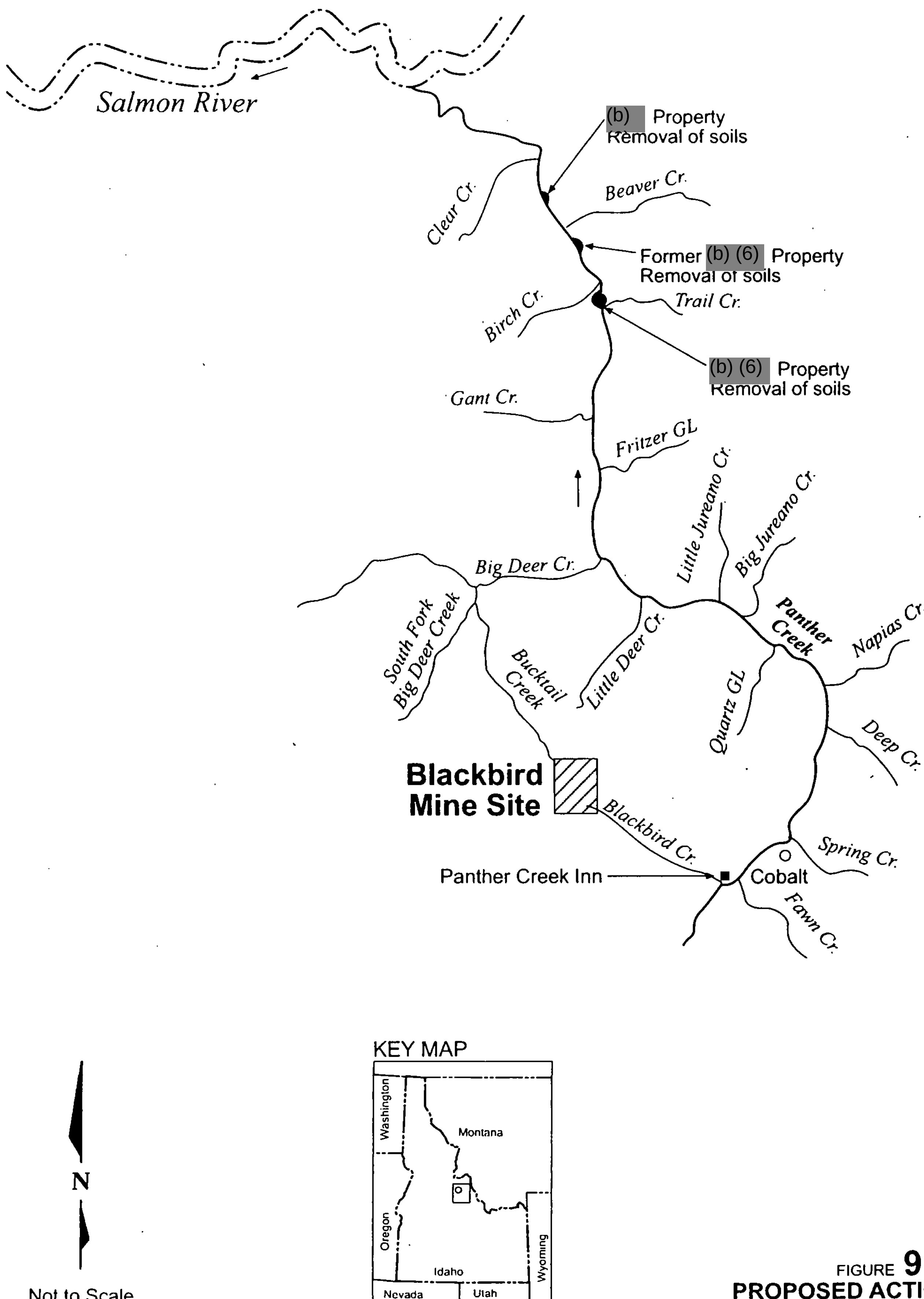
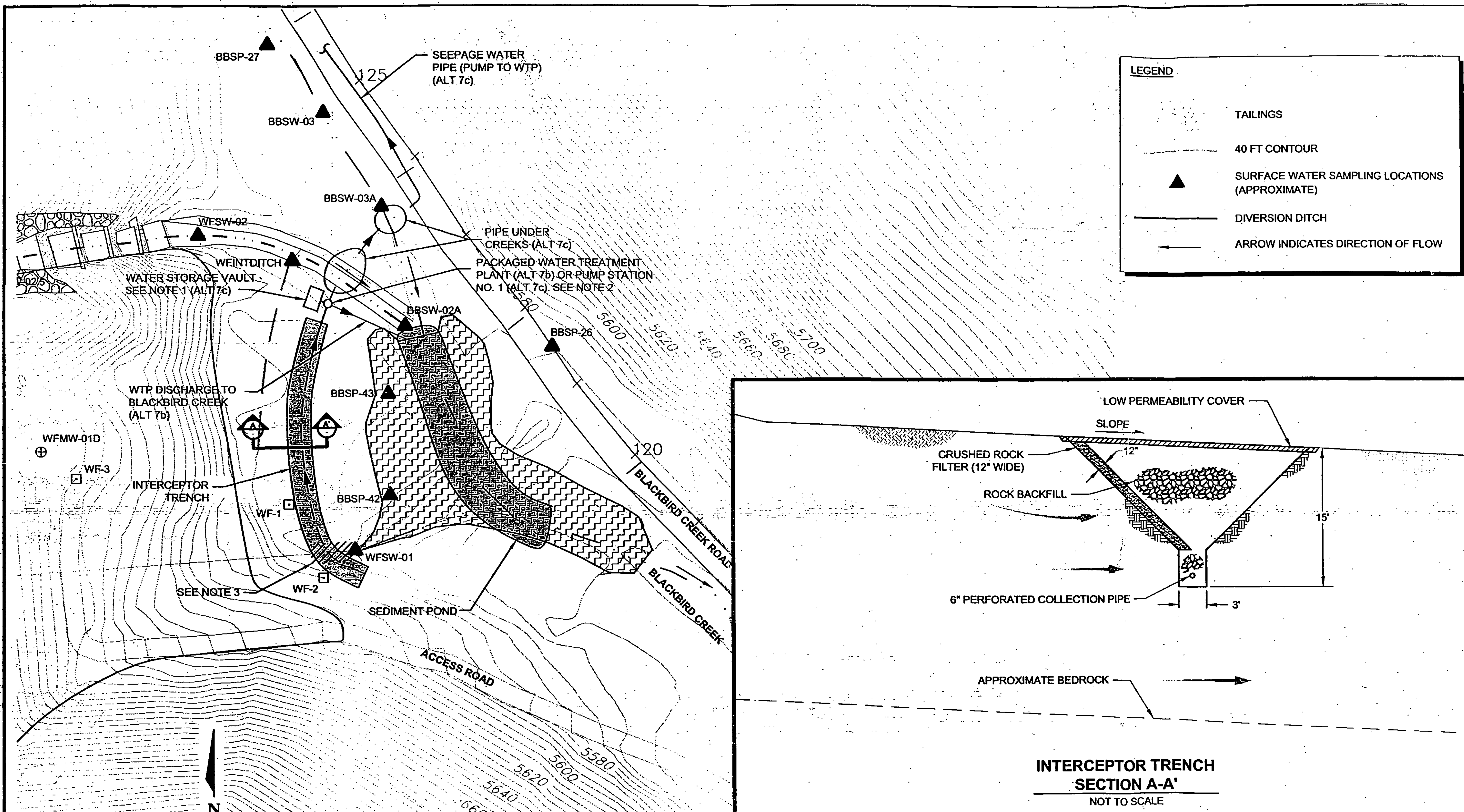


FIGURE **9-13**
PROPOSED ACTIONS
PANTHER CREEK ALTERNATIVE P-3
BMSG/BLACKBIRD MINE SITE/ID

proj\152238\ROD FILES\FINAL ROD FIGURES\FIG9-13 FH10 21-JAN-2003

After Golder Associates

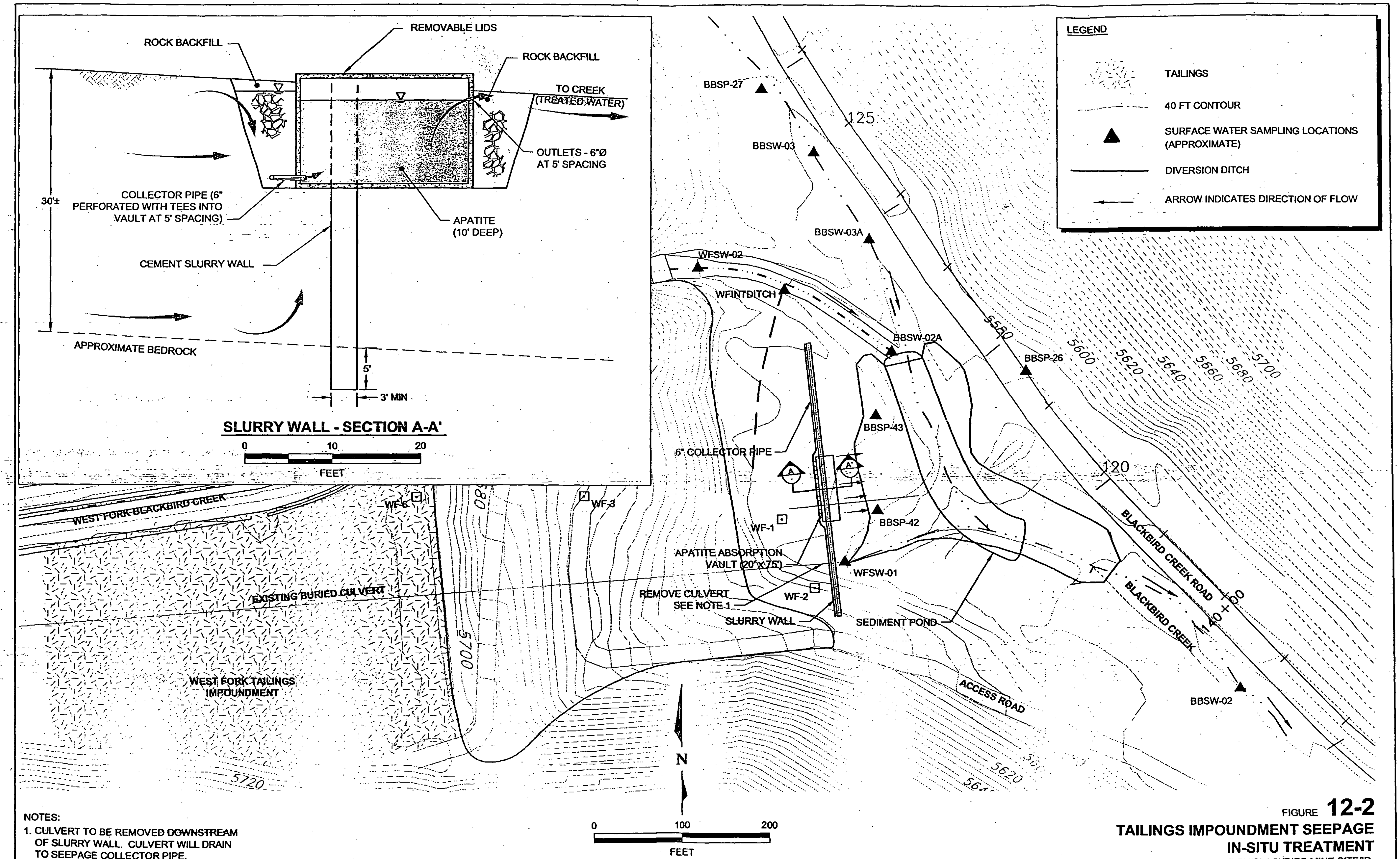


NOTES:

1. 5000 GALLON STORAGE VAULT. NORMALLY EMPTY. VAULT AVAILABLE FOR DRAIN DOWN OF PUMP LINE IF NECESSARY.
2. A TOTAL OF 4 PUMP STATIONS WILL BE UTILIZED TO PUMP SEEPAGE WATER TO THE 7100 DAM, OR 3 IF PUMPING DIRECTLY TO THE WTP.
3. REMOVE CULVERT DOWNSTREAM OF INTERCEPTOR TRENCH.

FIGURE **12-1**
TAILINGS IMPOUNDMENT SEEPAGE IN-SITU ACTIVE TREATMENT OR COLLECTION-PUMP BACK
FEASIBILITY STUDY/BLACKBIRD MINE SITE/ID

After Golder Associates



NOTES:

1. CULVERT TO BE REMOVED DOWNSTREAM OF SLURRY WALL. CULVERT WILL DRAIN TO SEEPAGE COLLECTOR PIPE.

FIGURE **12-2**

TAILINGS IMPOUNDMENT SEEPAGE IN-SITU TREATMENT

FEASIBILITY STUDY/BLACKBIRD MINE SITE/ID

Drawing file: 94315950040500F09.dwg Jan 22, 2003 – 11:11am

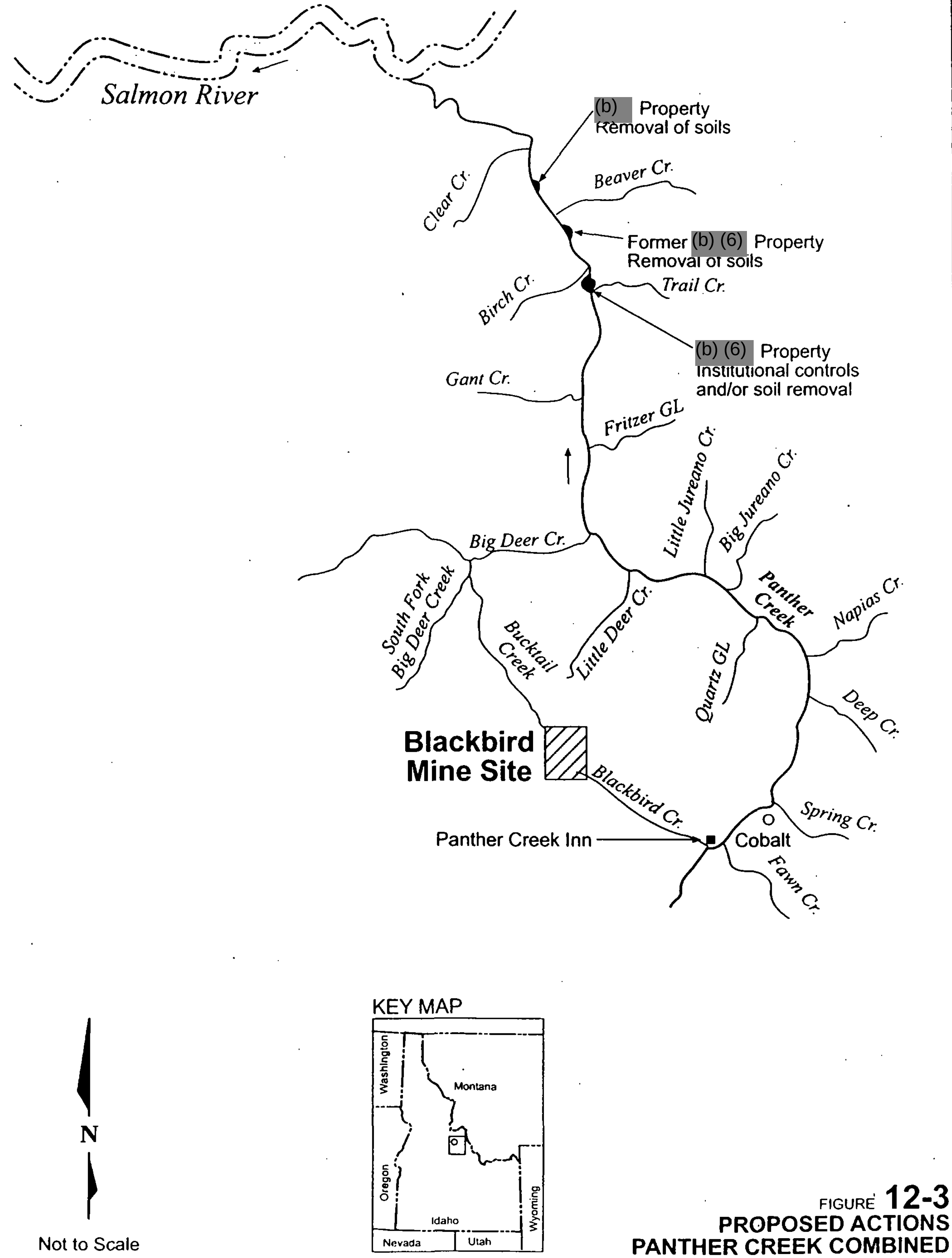


FIGURE 12-3
PROPOSED ACTIONS
PANTHER CREEK COMBINED
ALTERNATIVES P-2 AND P-3
BMSG/BLACKBIRD MINE SITE/ID

proj\15223\ROD FILES\FINAL ROD FIGURES\FIG12-3.FH10 22-JAN-2003

After Golder Associates

B

TABLE 5-1b

ANALYTICAL RESULTS FOR PRIVATE WATER SUPPLIES SAMPLED

Parameters	Date Location Id Number Filt/Unfiltere	06/26/9 5 PCI Well No. 1 950245	09/18/0 2 PCI Well No. 1	09/18/0 2 PCI Well No. 2	09/22/95 (b) (6) (b) (6) 952327 U	09/22/9 5 (b) (6) S CABIN	09/22/9 5 (b) (6) S HOUSE	09/22/95 (b) (6) (952324
	Units							
LAB								
Alkalinity	µg/L as		15300	47600		123000	124000	82000
Aluminum	µg/L				63.3 B	41.6 B	38.4 B	20.4 U
Arsenic	µg/L	3 BJ	2	16	77.8	1.5 U	1.5 U	22.8
Calcium	µg/L		18900	20900	23400	40300	41300	21800
Chloride	µg/L		5200	10000		2480	2470	2900
Cobalt	µg/L	244	290	208	11.5 B	4.9 U	4.9 U	4.9 U
Copper	µg/L	18.6 B	22	35	0.6 U	0.6 U	0.69 B	3.1 B
Iron	µg/L		40	3700	85.2 B	100	116	16.5 U
Magnesium	µg/L		5880	5580	3620 B	5570	5700	4760 B
Manganese	µg/L	10.7 B	3	2120	1.1 U	4.3 U	6.5 U	4.8 U
Nickel	µg/L	11.7 U			14.4 U	14.4 U	14.4 U	14.4 U
Potassium	µg/L		3900	5900	2290 B	4960 B	5010	2400 B
Silicon	µg/L				7800 J	6140 J	6400 J	4020 J
Sodium	µg/L		3400	5900	7170	5650	5740	6940
Sulfate	µg/L		62600	43600		18400	18300	11500
Total Dissolved Solids	µg/L		156000	151000		129000	142000	76000
Total Suspended	µg/L		500	3500		1400	1300	100 U
FIELD								
Conductivity	µS/cm	210	130	159		260		178
Dissolved Oxygen	mg/L	13.4	6.06	6.2		10.9		1.96
pH	Std Unit	6.17	6.87	6.53		7.64		7.85
Temperature	°C	13.5	12.7	10.4		8.1		11.6
Turbidity	NTU	2	2	5		1		

B = Analyte detected at a value between the minimum detection limit and the practical quantitation limit
J = Estimated value
U = Non-detect

Note: Blanks indicate analysis for the parameter was not performed.

Table 5-1b.xls

After Golder Associates

TABLE 5-2

SUMMARY OF SURFACE SAMPLING FOR WASTE ROCK REMAINING AFTER EARLY ACTIONS

Location	Number of Samples	Copper Min (mg/kg)	Copper Max (mg/kg)	Copper Mean (mg/kg)	Copper Median (mg/kg)	Cobalt [3] Min (mg/kg)	Cobalt [3] Max (mg/kg)	Cobalt [3] Mean (mg/kg)	Cobalt [3] Median (mg/kg)	Arsenic Min (mg/kg)	Arsenic Max (mg/kg)	Arsenic Mean (mg/kg)	Arsenic Median (mg/kg)
Haynes-Stellite Area	14	21.0	324.0	130.2	122.5	20.0	3210.0	361.4	177.5	6.1	5550.0	568.9	129.5
Upper Meadow Creek Drainage - 7300 WRD and 7400 WRD	3	830.0	2450.0	1460.0	1100.0	-	-	-	-	660.0	1290.0	880.0	690.0
Meadow Creek North End - 7700 WRD [5]	4	200.0	1400.0	750.0	700.0	-	-	-	-	75.0	940.0	291.3	75.0
Meadow Creek West Side - 7800 WRD	50	200.0	20200.0	1905.8	875.0	-	-	-	-	75.0	5900.0	956.1	475.5
Bucktail Drainage - Remaining West Lobe	16	660.0	2700.0	1738.1	1850.0	-	990.0	-	-	75.0	2200.0	1251.6	1155.0
Bucktail Drainage - East Slope WRD	40	200.0	13000.0	1754.0	1300.0	-	1050.0	-	-	75.0	3200.0	843.6	730.0
7117 WRD	14	200.0	7370.0	1355.0	735.0	-	-	-	-	75.0	3160.0	484.1	147.5
7265 WRD	4	430.0	4030.0	1475.0	720.0	-	-	-	-	75.0	939.0	414.8	322.5

Notes:
1. WRD = Waste Rock Dump
2. Non-detect results were set to a value equal to half the detection limit (detection limits varied from data set to data set).
3. Aside from the Haynes-Stellite Area, most samples tested below the XRF detection limit for cobalt. A "-" indicates that all samples in the area tested below the detection limit.
4. Data compiled from Golder (1996d), Golder (1996f), Golder (1997d), and Beltman et. al. (1993)
5. Many samples had arsenic concentrations below the XRF detection limits; therefore, the median and minimum reflect one-half the detection limit.

Table 5-3

Summary of West Fork Tailings Impoundment Soil Sampling

Location	As (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	S (mg/kg)
West Fork Transect 1 (Composite of Samples 1-4)	554	640	39900	ND
West Fork Transect 2 (Composite of Samples 5-8)	389	410	34100	ND
West Fork Transect 3 (Composite of Samples 9-12)	298	171	16800	ND
West Fork Transect 4 (Composite of Samples 13-16)	273	182	24500	ND
West Fork Transect 5 (Composite of Samples 17-20)	533	650	33700	ND

Note: Four discreet samples were collected for each transect and analyzed with XRF

TABLE 5-4

SUMMARY OF LOWER BUCKTAIL DEBRIS-FLOW SAMPLING FOR DEPOSITS REMAINING AFTER EARLY ACTIONS

Location	Number of Samples	Copper Min (mg/kg)	Copper Max (mg/kg)	Copper Mean (mg/kg)	Copper Median (mg/kg)	Cobalt [1] Min (mg/kg)	Cobalt [1] Max (mg/kg)	Cobalt [1] Mean (mg/kg)	Cobalt [1] Median (mg/kg)	Arsenic Min (mg/kg)	Arsenic Max (mg/kg)	Arsenic Mean (mg/kg)	Arsenic Median (mg/kg)
Lower Bucktail													
Between Upper and Lower Sediment Dams	80	265.0	14690.0	3921.6	2756.5	125.0	1429.0	183.4	125.0	46.0	1205.0	650.0	807.5

Notes:

1. Most of the samples tested below the detection limit for cobalt; therefore, the minimum, mean, and median reflect this result.
2. Data from Golder (1995h) and Golder (1997c).
3. Non-detect results were set to a value equal to half the detection limit (detection limits varied from data set to data set).

TABLE 5-5

SUMMARY OF OVERBANK SAMPLING FOR DEPOSITS REMAINING ALONG BLACKBIRD AND BIG DEER CREEKS AFTER EARLY ACTIONS [1]

Location	Number of Samples	Copper Min (mg/kg)	Copper Max (mg/kg)	Copper Mean (mg/kg)	Copper Median (mg/kg)	Cobalt Min (mg/kg)	Cobalt Max (mg/kg)	Cobalt Mean (mg/kg)	Cobalt Median (mg/kg)	Arsenic Min (mg/kg)	Arsenic Max (mg/kg)	Arsenic Mean (mg/kg)	Arsenic Median (mg/kg)
Big Deer Creek													
Big Deer Creek (Table 5-35 of this RI) [2]	17	49.8	17200.0	2069.8	654.0	15.2	619.0	129.7	53.4	7.0	72.3	25.1	19.6
Big Deer Creek (Golder 1996d) [3, 4, 6, 7]	18	150.0	4500.0	1990.3	2050.0	152.5	750.0	-	750.0	75.0	268.0	128.9	75.0
South Fork of Big Deer Creek (Golder 1996d) [3, 4]	7	2100.0	42000.0	11137.5	7450.0	750.0	1600.0	856.3	750.0	75.0	820.0	558.1	605.0
Blackbird Creek (from the base of 6850 Waste Rock Dump to just north of Panther Creek Inn)													
Areas Not Included in 1999 Removal Actions (Golder 1996d, 2000e) [4]	73	116.0	41000.0	1946.9	540.0	91.0	97700.0	3054.9	750.0	50.0	#######	5504.5	2100.0
Post-Removal Sampling in Areas Included in 1999 Removal Actions (Golder 2000e) [4, 5]	87	150.0	3000.0	807.9	570.0	NT	NT	NT	NT	50.0	20270.0	1790.6	970.0
Panther Creek Inn (including PCI Campground and East Campground)													
Areas Not Included in 1999 Removal Actions (Golder 1996d, 2000e)	3	72.0	116.0	97.7	105.0	62.0	94.0	80.3	85.0	46.0	64.0	57.7	63.0
Post-Removal Sampling in Areas Included in 1999 Removal Actions (BMSG 1999) [4,6]	73	150.0	4500.0	389.2	150.0	NT	NT	NT	NT	50.0	1900.0	334.8	50.0

Notes:
1. NT = Not Tested (or not presented).
2. These samples were analyzed in a laboratory, so their detection limits are lower than for the Big Deer Creek samples in Golder (1996d)
3. These samples were analyzed using XRF, so their detection limits are much higher than for the laboratory values presented in Table 5-32 of this RI
4. Non-detect results were assigned a value equal to one-half the detection limit (detection limits varied from data set to data set).
5. These samples are post-removal samples (i.e., samples taken from areas subsequent to overbank deposit removal).
6. Many samples had arsenic concentrations below the XRF detection limits; therefore, the median and minimum reflect one-half the detection limit.
7. All of the samples analyzed for cobalt by XRF had non-detect results. The minimum cobalt concentration is from a laboratory-analyzed sample.

TABLE 5-6

05-Mar SUMMARY OF SAMPLING FOR OTHER SOILS[1]

Location	Number of Samples	Copper Min (mg/kg)	Copper Max (mg/kg)	Copper Mean (mg/kg)	Copper Median (mg/kg)	Cobalt[4] Min (mg/kg)	Cobalt[4] Max (mg/kg)	Cobalt[4] Mean (mg/kg)	Cobalt[4] Median (mg/kg)	Arsenic Min (mg/kg)	Arsenic Max (mg/kg)	Arsenic Mean (mg/kg)	Arsenic Median (mg/kg)
Panther Creek Road[2]	5	24	137	62	59	6	66	28	23	8	67	36	40
Soils in Areas Surrounding Waste-Rock Dumps[3, 4]	38	200	2100	557	450	400	4500	665	400	75	3500	407	310
Diversion Ditches Near Waste-Rock Dumps[3, 4, 5]	32	200	3300	1013	825	400	840	414	400	75	3800	373	75
Mine Road in Meadow Creek Basin	10	778	1380	1032	1000	120	300	180	170	302	1040	711	702
Mine Road in Bucktail Creek Basin	5	1430	2330	1920	1780	143	196	176	184	60	2430	1187	1320

Notes:

1. For soils not included as part of the waste-rock, debris flow, or overbank data sets. Detection limits were 400 mg/kg for copper, 800 mg/kg for cobalt, and 150 mg/kg for arsenic. Non-detect results were assigned a value equal to one-half the detection limit.
2. Data from CH2M Hill (1999).
3. Data from Golder (1996f).
4. Almost all of the samples tested below the detection limit for cobalt; therefore, the median and minimum reflect one-half the detection limit.
5. Many samples tested below the detection limit for arsenic; therefore, the median and minimum reflect one-half the detection limit.

TABLE 5-7

Comparison of Golder 1995 and 2000 Sediment Metal Concentrations (HCl/HNO_3 digestion)

Site	Date	Distance from Mouth	Arsenic	Cobalt	Copper	Iron	Manganese
		miles	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BB-18	08/17/1995	6	73.2	71.7	256	57500	468
BBSW-08	09/21/2000		28.7	17.5	422	32800	216
RPD			87%	122%	49%	55%	74%
BB-2A	08/16/1995	0.2	847	628	2490	49900	1100
BBSW-01	09/21/2000		555	426	1510	55700	826
RPD			42%	38%	49%	11%	28%
PCS Site 11-04	08/15/1995	21.5	72.8	264	450	25300	463
PASW-08	09/21/2000		203	130	141	16700	299
RPD			94%	68%	105%	41%	43%
PCS Site 10	08/17/1995	19.3	65.1	243	162	18700	383
PCS Site 10	08/17/1995		65.7	237	174	21700	387
PASW-07	09/21/2000		54.2	198	94.7	16900	343
RPD (using average of 1995 data)			19%	19%	56%	18%	12%
PCS Site 7	08/15/1995	12.9	93	117	1450	19100	215
PASW-05	09/21/2000		22.2	84.7	56.5	10600	230
RPD			123%	32%	185%	57%	7%
PCS Site 1	08/15/1995	1.3	10.2	54.6	55.9	20500	238
PASW-01	09/21/2000		10.1	48.1	62.1	10300	138
RPD			1%	13%	11%	66%	53%
SF-4	08/18/1995	0.6	20.8	19.4	86.4	22100	450
SFSW-04	09/21/2000		30	8.2	154	23100	509
RPD			36%	81%	56%	4%	12%
SF-1A	08/18/1995	0	448	499	7350	40700	497
SFSW-01	09/21/2000		176	366	6400	35500	488
RPD			87%	31%	14%	14%	2%
BD-8	08/16/1995	3.2	3.3	3.4	12	6590	116
BDSW-04	09/21/2000		1	1.4	29.7	4490	80.4
RPD			107%	83%	85%	38%	36%

RPD - relative percent difference.

Fall 2000 total metal data from HCl/HF digestion not included in comparison.

After Golder Associates

Table 5-8

Comparison of Sediment Total Metal Concentrations to PRG's

Station	Distance from Mouth	Date	% Solids	As mg/kg	Co mg/kg	Cu mg/kg
Blackbird Creek PRG				35	436	637
BBSW-08	6	09/21/2000	99.7	28.7	17.5	422
BBSW-08	6	10/16/2001		**44.2**	37.1	144
BBSW-07	4.5	09/21/2000	99.6	**663**	**713**	**3240**
BBSW-07	4.5	10/16/2001		**712**	**717**	**4250**
BBSW-03	3.3	09/21/2000	99.3	**1330**	346	**3320**
BBSW-03	3.3	10/16/2001		**978**	377	**2050**
BBSW-01	0.2	09/21/2000	99.1	**555**	426	**1510**
BBSW-01	0.2	10/16/2001		**563**	**546**	**709**
Panther Creek PRG				35	83	151
PASW-01	1.3	09/21/2000	99.9	10.1	48.1	62.1
PASW-01	1.3	10/16/2001		14.6	53.1	76.6
PASW-04	11.5	09/21/2000	99.9	**38.9**	60.8	**231**
PASW-04	11.5	10/16/2001		**40.1**	71.3	**313**
PASW-05	12.9	09/21/2000	99.8	22.2	**84.7**	56.5
PASW-05	12.9	10/16/2001		26.7	**91**	**181**
PASW-07	19.3	09/21/2000	99.8	**54.2**	**198**	94.7
PASW-07	19.3	10/16/2001		**115**	**154**	**201**
PASW-08	21.5	09/21/2000	99.6	**203**	**130**	141
PASW-08	21.5	10/16/2001		**152**	**246**	**300**
PASW-10	23.7	09/21/2000	99.8	**50**	79.1	61
PASW-10	23.7	10/16/2001		**83.7**	**86.5**	82.2
PASW-11	25	09/21/2000	99.5	6.4	3.1	39.5
PASW-11	25	10/16/2001		14.6	19.8	14.1
South Fork Big Deer Creek PRG				35	436	637
SFSW-04	0.6	09/21/2000	99.5	30	8.2	**154**
SFSW-04	0.6	09/20/2001		27.4	12.1	312
SFSW-01	0	09/21/2000	99.8	**176**	366	**6400**
SFSW-01	0	09/20/2001		**158**	397	**7410**
Big Deer Creek PRG				35	83	151
BDSW-01	0	09/21/2000	100	5.7	69.8	**385**
BDSW-01	0	09/20/2001		5.5	53.8	**301**
BDSW-02	2.1	09/21/2000	99.9	7.1	37.4	**215**
BDSW-02	2.1	09/20/2001		12.6	40	**189**
BDSW-04	3.2	09/21/2000	99.9	1	1.4	29.7
BDSW-04		09/20/2001		2.1	2.3	12.7
Bucktail Creek						
BTSW-01.1	0.1	09/20/2001		228	776	10900
BTSW-02	2.1	09/20/2001		371	812	8716

Notes: --Results presented in **bold** exceeded In Stream Sediment PRG's
--No PRG's have been established for Bucktail Creek

Table 5-8.xls **After Golder Associates**

Table 5-9
Summary of Periodic Sampling Results for Cobalt in Blackbird Creek (BBSW-01A) and Panther Creek (PASW-09)

		Cobalt	
		Dissolved	Total
Blackbird Creek Station	Date	Conc. (mg/L)	Conc. (mg/L)
BBSW-01A	12/22/2001	0.63	0.644
BBSW-01A	01/15/2002	0.666	0.676
BBSW-01A	02/18/2002	0.65	0.636
BBSW-01A	03/12/2002	0.674	0.691
BBSW-01A	03/15/2002	0.748	0.78
BBSW-01A	03/24/2002	0.541	0.571
BBSW-01A	04/09/2002	0.222	0.218
BBSW-01A	04/17/2002	0.157	0.162
BBSW-01A	04/24/2002	0.185	0.186
BBSW-01A	05/01/2002	0.11	0.114
BBSW-01A	05/06/2002	0.099	0.104
BBSW-01A	05/17/2002	0.082	0.092
BBSW-01A	05/23/2002	0.09	0.098
BBSW-01A	06/04/2002	0.1	0.102
BBSW-01A	06/21/2002	0.154	0.166
BBSW-01A	07/30/2002	0.209	0.22
BBSW-01A	08/19/2002	0.300	0.315
BBSW-01A	09/18/2002	0.462	0.499
BBSW-01A	10/18/2002	0.516	0.535
BBSW-01A	11/12/2002	0.581	0.582
PASW-09	12/22/2001	0.05	0.053
PASW-09	01/15/2002	0.062	0.064
PASW-09	02/18/2002	0.064	0.065
PASW-09	03/12/2002	0.099	0.107
PASW-09	03/15/2002	0.11	0.118
PASW-09	03/24/2002	0.079	0.087
PASW-09	04/09/2002	0.061	0.063
PASW-09	04/17/2002	0.05	0.053
PASW-09	04/24/2002	0.048	0.05
PASW-09	05/01/2002	0.032	0.034
PASW-09	05/06/2002	0.033	0.036
PASW-09	05/17/2002	0.026	0.03
PASW-09	05/23/2002	0.021	0.025
PASW-09	06/04/2002	0.016	0.021
PASW-09	06/21/2002	0.014	0.016
PASW-09	07/30/2002	0.015	0.02
PASW-09	08/19/2002	0.023	0.026
PASW-09	09/18/2002	0.044	0.045
PASW-09	10/18/2002	0.0448	0.049
PASW-09	11/07/2002	0.05(a)	
PASW-09	11/12/2002	0.0614	0.0621

(a) Sample collected by E. Modroo/IC

TABLE 5-10

Summary of Surface Water Reference Station Concentrations (mg/L) by Creek

Parameter	Location	1998		1999		2000	
		High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow
Cobalt (Dissolved)	ICSW-01					0.003 ND[a]	0.003 ND
	WFSW-02.5	0.007	0.006	0.003 ND	0.003 ND	0.003 ND	0.003 ND
	BBSW-08						0.003 ND
	PASW-11	0.002 ND	0.005	0.003 ND	0.003 ND	0.003 ND	0.003 ND
	SFSW-04					0.006	0.003 ND
	SFSW-03		0.002 ND	0.003 ND	0.003 ND	0.003 ND	
	BDSW-04		0.002 ND	0.003 ND	0.003 ND	0.007	0.003 ND
Copper (Dissolved)	ICSW-01					0.004	0.002 ND
	WFSW-02.5	0.007	0.002 ND	0.002 ND	0.002 ND	0.002 ND	0.002 ND
	BBSW-08						0.002 ND
	PASW-11	0.002 ND	0.002 ND	0.002 ND	0.008[b]	0.002 ND	0.002 ND
	SFSW-04					0.004	0.002 ND
	SFSW-03		0.01	0.02[c]	0.004[c]	0.005[c]	
	BDSW-04		0.002 ND	0.02[d]	0.01[e]	0.002 ND	0.002 ND
Iron (Total)	ICSW-01					0.04	0.1
	WFSW-02.5	0.5	0.2	0.2	0.1	0.1	0.07
	BBSW-08						0.06
	PASW-11	0.8	0.3	0.9	0.2	0.5	0.2
	SFSW-04					0.04	0.01 ND
	SFSW-03		0.010 ND	0.05	0.04	0.01 ND	
	BDSW-04		0.010 ND	0.2	0.01 ND	0.2	0.06

Notes:

[a]ND: Maximum exposure concentration is based on non-detected results (i.e., no results were reported above the detection limit). The value shown is one-half the detection limit.

[b]The dissolved copper value appears to be anomalous. This value appears to be the total copper value, rather than dissolved copper.

[c]Apparently anomalous results. The background station was moved upstream to SFSW-04 in 2000 to remove any possible interference from the lower Sediment Dam spillway.

[d]Apparently anomalous result. The dissolved sample results were greater than the total sample value, and copper was detected in the QA/QC blank sample.

[e]Apparently anomalous result. The downstream station (BDSW-03) had lower copper values than BDSW-04.

TABLE 5-11
Summary of 95% Upper Tolerance Levels for Background Sediment Data

Area	Parameter	Units	95% UTL
Mineralized	Arsenic	mg/kg	34.8
Mineralized	Cobalt	mg/kg	436
Mineralized	Copper	mg/kg	637
Mineralized	Iron	mg/kg	51,900
Panther Creek	Arsenic	mg/kg	34.8
Panther Creek	Cobalt	mg/kg	38.8
Panther Creek	Copper	mg/kg	87.4
Panther Creek	Iron	mg/kg	51,900

Notes:
UTL – Upper Tolerance Level

TABLE 5-12

SELECTED SUMMARY OF PRE-RI BACKGROUND SOIL CONCENTRATION DATA[1,2,3]

Location	Copper		Cobalt		Arsenic		Comment
	Min	Max	Min	Max	Min	Max	
Blacktail open pit area prior to mining disturbance	60	2400	10	400	NT	NT	371 samples; Median values: Cu = 150 ppm; Co = 60 ppm
Banks of Blackbird Creek above Meadow Creek	30	700	10	100	NT	NT	Transect of 66 samples; Median values: Cu = 100 ppm; Co = 20 ppm
North side of Blackbird mining area	4	479	6	273	NT	NT	
Forest topsoil north of open-pit waste pile	1268	1441	122	142	8	10	two samples
Indian Creek	11	541	9	436	NT	NT	
Elkhorn Creek	5	1500	<5	700	<5	900	nine samples
Lower Panther Creek Canyon	5	1500	7	10	<5	500	

Notes:

1. Adapted from Mebane (1994a); for undisturbed soils in the vicinity of Blackbird mining area.
2. All concentrations are in mg/kg dry weight unless noted otherwise.
3. NT means not tested.

TABLE 5-13

BACKGROUND SOIL CONCENTRATION DATA COLLECTED DURING THE RI[1]

Location	Copper		Cobalt		Arsenic		Comment
	Min	Max	Min	Max	Min	Max	
Riparian (n = 15; Medians: Cu =24.9; Co =14.4 ; As =17.6 . Mean values: Cu =122.3; Co =39.4; As =62.6)							
Big Deer Creek[2]	17.0	26.9	7.4	9.6	5.9	18.4	n = 2
Blacktail Ridge[2]	9.7		8.3		4.9		Single sample
East Blacktail Pit[2]	31.1	1425.0	14.2	314.0	11.1	637.5	n = 4
West Fork Blackbird Creek above Tailings Impoundment[2]	96.8		66.3		59.0		Single sample
Ludwig Gulch[2]	12.9	28.2	10.6	35.6	14.4	43.7	n = 6
Panther Creek Upstream of Blackbird Creek[2]	24.9		10.4		14.1		Single sample
Panther Creek Downstream of Panther Creek Inn[3]	14.0	71.7	4.0	62.0	12.4	57.8	n = 9; Medians: Cu = 27.2; Co = 18.5; As = 32.3. Mean values: Cu = 28.9; Co = 21.1; As = 29.8.
Borrow Soils[3]	15.7	130.0	12.7	71.6	7.7	158.0	n = 37; Medians: Cu = 35.5; Co = 29.4; As = 39.8. Mean values: Cu = 42.1; Co = 35.5; As = 48.6.

Notes:

1. All concentrations are in mg/kg dry weight.
2. From Golder (1996d). Concentrations for a sample are the average from the –10 and –200 fractions.
3. From Golder (1999b) and CH2M Hill (1999).

Table 5-14
Background Samples
Panther Creek Overbank Deposits
Blackbird Mine Site

Sample ID	Sampling Event	Arsenic Concentration (mg/kg)
CT-1	1998 Borrow Material	9.9
CT-2	1998 Borrow Material	2
CT-3	1998 Borrow Material	10.5
CT-4	1998 Borrow Material	17
CT-5	1998 Borrow Material	6
CT-6	1998 Borrow Material	14
CT-7	1998 Borrow Material	15.2
CT-8	1998 Borrow Material	13.4
CT-9	1998 Borrow Material	15.7
CT-10	1998 Borrow Material	33.5
CT-11	1998 Borrow Material	22.7
CT-12	1998 Borrow Material	7.7
CT-13	1998 Borrow Material	49.1
CT-14	1998 Borrow Material	2
990001	1999 Borrow Material	66.1
990002	1999 Borrow Material	62.9
990003	1999 Borrow Material	53.9
990004	1999 Borrow Material	39.8
990005	1999 Borrow Material	87.6
990006	1999 Borrow Material	158
990007	1999 Borrow Material	51.4
990008	1999 Borrow Material	31.2
990009	1999 Borrow Material	26.6
990010	1999 Borrow Material	131
990011	1999 Borrow Material	97
990012	1999 Borrow Material	26
990013	1999 Borrow Material	45.3
990014	1999 Borrow Material	39.1
990015	1999 Borrow Material	63.4
990016	1999 Borrow Material	15.5
990017	1999 Borrow Material	69.2
990018	1999 Borrow Material	50.1
990019	1999 Borrow Material	14.3
990020	1999 Borrow Material	43.8
990021	1999 Borrow Material	70.4
990022	1999 Borrow Material	62.9
990023	1999 Borrow Material	53.3
661564	1995 Riparian Background Areas	6.7
661565	1995 Riparian Background Areas	6.2
741573	1995 Riparian Background Areas	63.3
821584	1995 Riparian Background Areas	14.5
821585	1995 Riparian Background Areas	11.7
981380	1998 Overbank Deposit Areas	37.8
981358	1998 Overbank Deposit Areas	43

Table 5-14
Background Samples
Panther Creek Overbank Deposits
Blackbird Mine Site

Sample ID	Sampling Event	Arsenic Concentration (mg/kg)
981426	1998 Overbank Deposit Areas	57.8
981436	1998 Overbank Deposit Areas	32.3
981439	1998 Overbank Deposit Areas	19.1
981445	1998 Overbank Deposit Areas	17.9
981466	1998 Overbank Deposit Areas	15
981521	1998 Overbank Deposit Areas	32.5
981522	1998 Overbank Deposit Areas	32.3

Table 7-1
Surface Soil/Mine Wastes Exposure Assumptions
Record of Decision
Blackbird Mine Site

Exposure Parameter		Reasonable Maximum Exposure (RME) Scenario																
		Adult Occupational Worker Blackbird Mine	Adult Recreational Day-Users Blackbird Mine	Teen Recreational Day-Users Blackbird Mine	Adult Recreational Day-Users Upper Blackbird Creek	Child Recreational Day-Users Upper Blackbird Creek	Adult Occupational Worker Upper Blackbird Creek	Adult Recreational Day-Users Lower Blackbird Creek	Child Recreational Day-Users Lower Blackbird Creek	Adult Recreational Day-Users West Fork Blackbird Creek	Child Recreational Day-Users West Fork Blackbird Creek	Adult Occupational Worker West Fork Blackbird Creek	Adult Recreational Campers South Fork Big Deer Creek/ Big Deer Creek	Child Recreational Campers South Fork Big Deer Creek/ Big Deer Creek	Adult Recreational Day-Users South Fork Big Deer Creek/ Big Deer Creek	Child Recreational Day-Users South Fork Big Deer Creek/ Big Deer Creek	Adult Recreational Day-Users Bucktail Creek	Teen Recreational Day-Users Bucktail Creek
Exposure Frequency (days/year)	EF	167	7	7	7	7	7	14	14	14	14	7	14	14	14	14	7	7
Exposure Time (hours/day)	ET	2	2	2	2	2	2	2	2	2	2	2	16	14	2	2	2	2
Exposure Duration (years)	ED	25	30	6	30	6	25	30	6	30	6	25	30/6	30/6	30/6	30/6	30	6
Ingestion Rate (mg/day)	IngR	50	100	100	100	300	50	100	300	100	300	50	100	300	100	300	100	100
Inhalation Rate (m_3/day)	InhR	20	20	10	20	10	20	20	10	20	10	20	20	10	20	10	20	10
Skin Surface Area (cm_2)	SA	2,500	4,800	3,500	4,800	2,200	2,500	4,800	2,200	4,800	2,200	2,500	4,800	2,200	4,800	2,200	4,800	3,500
Body Weight (kg)	BW	70	70	45	70	15	70	70	15	70	15	70	70	15	70	15	70	45
Averaging Time for Carcinogens (yr)	ATc	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Averaging Time for Noncarcinogens (yr)	ATnc	30	30	6	30	6	30	30	6	30	6	30	30	6	30	6	30	6
Bioavailability Factor for Arsenic (unitless)	BAF	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
1/Particulate Emission Factor (kg/m_3)	1/PEF	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10
Absorption Factor for Arsenic (unitless)	ABS	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Absorption Factor for other Inorganics (unitless)	ABS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soil-Skin Adherence Factor (mg/cm_2/day)	AF	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.2

Table 7-2
Sediment Exposure Assumptions
Record of Decision
Blackbird Mine Site

Exposure Parameter		Reasonable Maximum Exposure (RME) Scenario																
		Adult Occupational Worker Blackbird Mine	Adult Recreational Day-Users Blackbird Mine	Teen Recreational Day-Users Blackbird Mine	Adult Recreational Day-Users Upper Blackbird Creek	Child Recreational Day-Users Upper Blackbird Creek	Adult Occupational Worker Upper Blackbird Creek	Adult Recreational Day-Users Lower Blackbird Creek	Child Recreational Day-Users Lower Blackbird Creek	Adult Recreational Day-Users West Fork Blackbird Creek	Child Recreational Day-Users West Fork Blackbird Creek	Adult Occupational Worker West Fork Blackbird Creek	Adult Recreational Campers South Fork Big Deer Creek/ Big Deer Creek	Child Recreational Campers South Fork Big Deer Creek/ Big Deer Creek	Adult Recreational Day-Users South Fork Big Deer Creek/ Big Deer Creek	Child Recreational Day-Users South Fork Big Deer Creek/ Big Deer Creek	Adult Recreational Day-Users Bucktail Creek	Teen Recreational Day-Users Bucktail Creek
Exposure Frequency (days/year)	EF	167	7	7	7	7	7	14	14	14	14	7	14	14	14	14	7	7
Exposure Time (hours/day)[a]	ET	2	1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1
Exposure Duration (years)	ED	25	30	6	30	6	25	30	6	30	6	25	30	6	30	6	30	6
Ingestion Rate (mg/day)	IngR	50	100	100	100	300	50	100	300	100	300	50	100	300	100	300	100	100
Inhalation Rate (m^3/day)	InhR	20	20	10	20	10	20	20	10	20	10	20	20	10	20	10	20	10
Skin Surface Area (cm^2)	SA	2,500	4,800	3,500	4,800	2,200	2,500	4,800	2,200	4,800	2,200	2,500	4,800	2,200	4,800	2,200	4,800	3,500
Body Weight (kg)	BW	70	70	45	70	15	70	70	15	70	15	70	70	15	70	15	70	45
Averaging Time for Carcinogens (yr)	ATc	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Averaging Time for Noncarcinogens (yr)	ATnc	30	30	6	30	6	30	30	6	30	6	30	30	6	30	6	30	6
Bioavailability Factor for Arsenic (unitless)	BAF	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
1/Particulate Emission Factor (kg/m_3)	1/PEF	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10	7.60E-10
Absorption Factor for Arsenic (unitless)	ABS	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Absorption Factor for other Inorganics (unitless)	ABS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soil-Skin Adherence Factor ($mg/cm_2/day$)	AF	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.2

Notes:
a : The exposure time for workers is based on the assumption that workers are outside 2 out of 8 hours per work day. The exposure time for the other scenarios is based on the assumption that adults are awake 16 hours per day, spending 1 hour contacting sediment and surface water, and children are awake 14 hours per day, while spending 2 hours contacting sediment and surface water.
b : The Panther Creek exposure area includes the Panther Creek Inn.

Table 7-3
Surface Water Exposure Assumptions
Record of Decision
Blackbird Mine Site

		Reasonable Maximum Exposure (RME) Scenario																
Exposure Parameter		**Adult Occupational Worker Blackbird Mine**	**Adult Recreational Day-Users Blackbird Mine**	**Teen Recreational Day-Users Blackbird Mine**	**Adult Recreational Day-Users Upper Blackbird Creek**	**Child Recreational Day-Users Upper Blackbird Creek**	**Adult Occupational Worker Upper Blackbird Creek**	**Adult Recreational Day-Users Lower Blackbird Creek**	**Child Recreational Day-Users Lower Blackbird Creek**	**Adult Recreational Day-Users West Fork Blackbird Creek**	**Child Recreational Day-Users West Fork Blackbird Creek**	**Adult Occupational Worker West Fork Blackbird Creek**	**Adult Recreational Campers South Fork Big Deer Creek/ Big Deer Creek**	**Child Recreational Campers South Fork Big Deer Creek/ Big Deer Creek**	**Adult Recreational Day-Users South Fork Big Deer Creek/ Big Deer Creek**	**Child Recreational Day-Users South Fork Big Deer Creek/ Big Deer Creek**	**Adult Recreational Day-Users Bucktail Creek**	**Teen Recreational Day-Users Bucktail Creek**
Exposure Frequency (days/year)	EF	167	7	7	7	7	7	14	14	14	14	7	14	14	14	14	7	7
Exposure Time (hours/day)[a]	ET	2	1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1
Exposure Duration (years)	ED	25	30	6	30	6	25	30	6	30	6	25	30	6	30	6	30	6
Ingestion Rate (L/day)	IngR	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Skin Surface Area (cm$_2$)	SA	2,500	4,800	3,500	4,800	2,200	2,500	4,800	2,200	4,800	2,200	2,500	4,800	2,200	4,800	2,200	4,800	3,500
Body Weight (kg)	BW	70	70	45	70	15	70	70	15	70	15	70	70	15	70	15	70	45
Averaging Time for Carcinogens (yr)	ATc	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Averaging Time for Noncarcinogens (yr)	ATnc	30	30	6	30	6	30	30	6	30	6	30	30	6	30	6	30	6
Bioavailability Factor for Arsenic (unitless)	BAF	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Conversion Factor (L/cm$_3$)	CF	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Chemical Specific Permeability Constant (cm/hr)	PC	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Notes:
a : The exposure time for workers is based on the assumption that workers are outside 2 out of 8 hours per work day. The exposure time for the other scenarios is based on the assumption that adults are awake 16 hours per day, spending 1 hour contacting sediment and surface water, and children are awake 14 hours per day, while spending 2 hours contacting sediment and surface water.
b : The Panther Creek exposure area includes the Panther Creek Inn.

Table 7-4
Surface Soil/Mine Wastes Exposure Point Concentrations
Record of Decision
Blackbird Mine Site

Exposure Area	Chemical	Units	Exposure Point Concentration	EPC Basis
Blackbird Mine	Arsenic	mg/kg	867	NORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/kg	1,379	NORM
	Iron	mg/kg	78,412	NORM
Upper Blackbird Creek	Arsenic	mg/kg	4,918	LOGNORM
	Cobalt	mg/kg	2,111	LOGNORM
	Copper	mg/kg	1,222	LOGNORM
	Iron	mg/kg	113,346	LOGNORM
	Manganese	mg/kg	4,647	LOGNORM
Lower Blackbird Creek	Arsenic	mg/kg	2,010	LOGNORM
	Cobalt	mg/kg	23,492	NORM
	Copper	mg/kg	1,088	LOGNORM
	Iron	mg/kg	66,156	LOGNORM
	Manganese	mg/kg	25,619	LOGNORM
West Fork Blackbird Creek	Arsenic	mg/kg	2,205	LOGNORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
	Iron	- Iron was not identified as a COC -		
	Manganese	- Manganese was not identified as a COC -		
	Nickel	- Nickel was not identified as a COC -		
	Zinc	- Zinc was not identified as a COC -		
Bucktail Creek	Arsenic	mg/kg	572	NORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
South Fork Big Deer Creek/Big Deer Creek	Arsenic	mg/kg	108	LOGNORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/kg	7,544	LOGNORM
	Iron	- Iron was not identified as a COC -		
Panther Creek	-- Risks from exposure to surface soil in the Panther Creek exposure area are addressed in Attachment 1, Panther Creek Inn, and Attachment 2, Panther Creek Overbank Deposits --			

Notes:
EPC : Exposure Point Concentration
NORM : Exposure Point Concentration is based on the 95% Upper Confidence Limit assuming a normal distribution.
LOGNORM : Exposure Point Concentration is based on the 95% Upper Confidence Limit assuming a lognormal distribution.
NA : Not applicable. There are no detects, therefore a EPC is not calculated.
MAXDET(< MinNumSamples) : Maximum detected concentration is used when there are less than 10 samples in the data set.

Table 7-5
Sediment Exposure Point Concentrations
Record of Decision
Blackbird Mine Site

Exposure Area	Compound	Units	Exposure Point Concentration	Basis
Blackbird Mine	Arsenic	- Arsenic was not identified as a COC -		
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
	Iron	mg/kg	32,800	MAXDET (<MinNumSamps)
	Manganese	- Manganese was not identified as a COC -		
Upper Blackbird Creek	Arsenic	mg/kg	1,134	NORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/kg	3,579	LOGNORM
	Iron	mg/kg	81,161	LOGNORM
	Manganese	- Manganese was not identified as a COC -		
Lower Blackbird Creek	Arsenic	mg/kg	1,132	NORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/kg	2,886	NORM
	Iron	mg/kg	80,973	NORM
	Manganese	mg/kg	1,569	NORM
West Fork Blackbird Creek	Arsenic	mg/kg	1,230	MAXDET (<MinNumSamps)
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
	Iron	mg/kg	97,000	MAXDET (<MinNumSamps)
	Manganese	- Manganese was not identified as a COC -		
Bucktail Creek	Arsenic	mg/kg	371	MAXDET (<MinNumSamps)
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/kg	10,900	MAXDET (<MinNumSamps)
	Iron	- Iron was not identified as a COC -		
	Manganese	- Manganese was not identified as a COC -		
South Fork Big Deer Creek/Big Deer Creek	Arsenic	mg/kg	78	LOGNORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/kg	5644	LOGNORM
	Iron	mg/kg	24773	LOGNORM
	Manganese	Manganese was not identified as a COC		
Panther Creek	Arsenic	mg/kg	73	NORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
	Iron	mg/kg	20,104	LOGNORM
	Manganese	mg/kg	1,714	LOGNORM

Notes:
EPC : Exposure Point Concentration
NORM : Exposure Point Concentration is based on the 95% Upper Confidence Limit assuming a normal distribution.
LOGNORM : Exposure Point Concentration is based on the 95% Upper Confidence Limit assuming a lognormal distribution.
MAXDET : Maximum detected concentration is used as the EPC.

Table 7-6
Surface Water Exposure Point Concentrations
Record of Decision
Blackbird Mine Site

Exposure Area	Compound	Units	Exposure Point Concentration	Basis
Blackbird Mine	Arsenic	mg/L	0.17	LOGNORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
	Iron	mg/L	61.22	LOGNORM
	Manganese	mg/L	3.0	LOGNORM
Upper Blackbird Creek	Arsenic	mg/L	0.02	LOGNORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	mg/L	1.03	LOGNORM
	Iron	mg/L	5.16	LOGNORM
	Manganese	- Manganese was not identified as a COC -		
Lower Blackbird Creek	Arsenic	mg/L	0.03	LOGNORM
	Cobalt	- Cobalt was not identified as a COC -		
	Copper	- Copper was not identified as a COC -		
	Iron	mg/L	5.54	LOGNORM
	Manganese	- Manganese was not identified as a COC -		
West Fork Blackbird Creek	Arsenic	mg/L	0.01	LOGNORM
	Cobalt	mg/L	6.02	MAXDET
	Copper	mg/L	1.06	MAXDET
	Iron	mg/L	114	MAXDET
	Manganese	mg/L	3.85	MAXDET
Bucktail Creek	Arsenic	mg/L	0.02	LOGNORM
	Cobalt	mg/L	3.1	NORM
	Copper	mg/L	9	NORM
	Manganese	mg/L	1.8	LOGNORM
South Fork Big Deer Creek/Big Deer Creek	Arsenic	no COCs were identified for the South Fork Big Deer Creek/Big Deer Creek exposure area		
	Cobalt			
	Copper			
	Iron			
	Manganese			
Panther Creek	Arsenic	no COCs were identified for the Panther Creek exposure area		
	Cobalt			
	Copper			
	Iron			
	Manganese			

Notes:
EPC : Exposure Point Concentration
NORM : Exposure Point Concentration is based on the 95% Upper Confidence Limit assuming a normal distribution.
LOGNORM : Exposure Point Concentration is based on the 95% Upper Confidence Limit assuming a lognormal distribution.
MAXDET : Maximum detected concentration is used as the EPC.

Table 7-7
Risk Characterization Summary - Surface Soil/Mine Wastes
Record of Decision
Blackbird Mine Site

Exposure Area/Receptor	Reasonable Maximum Exposure Cancer Risk	Reasonable Maximum Exposure NonCancer Hazard Index	Central Tendency Exposure Cancer Risk	Central Tendency Exposure NonCancer Hazard Index
Blackbird Mine				
Adult Worker	3E-05	0.2	6E-06	0.1
Adult Day-User	2E-06	0.01	9E-07	1E-04
Teen Day-User	--	0.02	--	5E-04
Age-Adjusted Day-User	1E-05	--	1E-06	--
Upper Blackbird Creek				
Adult Day-User	9E-06	0.05	7E-07	0.01
Child Day-User	--	0.6	--	0.1
Age-Adjusted Day-User	3E-05	--	5E-06	--
Adult Worker	8E-06	0.06	1E-06	0.03
Lower Blackbird Creek				
Adult Day-User	8E-06	0.1	2E-07	0.03
Child Day-User	--	0.7	--	0.2
Age-Adjusted Day-User	2E-05	--	5E-06	--
West Fork Blackbird Creek				
Adult Day-User	4E-06	0.02	2E-07	0.01
Child Day-User	--	0.5	--	0.1
Age-Adjusted Day-User	3E-05	--	3E-06	--
Adult Worker	4E-06	0.03	1E-06	0.01
Bucktail Creek				
Adult Day-User	1E-06	0.008	2E-07	0.004
Teen Day-User	--	0.01	--	0.01
Age-Adjusted Day-User	6E-06	--	8E-07	--
South Fork/Big Deer Creek				
Adult Camper	3E-06	0.03	6E-07	0.003
Child Camper	--	0.3	--	0.04
Age-Adjusted Camper	3E-06	--	1E-06	--
Adult Day-User	4E-07	0.005	4E-08	0.002
Child Day-User	--	0.05	--	0.01
Age-Adjusted Day-User	1E-06	--	3E-07	--
Panther Creek				
Adult Day-User	-- Risks from exposure to surface soil in the Panther Creek exposure area are addressed in Attachment 1, Panther Creek Inn, and Attachment 2, Panther Creek Overbank Deposits --			
Child Day-User				
Age-Adjusted Day-User				

Notes:
NC = Not calculated; no Chemicals of Concern (COCs) were identified.
-- : Age-Adjusted cancer risk estimates including exposures to both adult and child receptors and are used to represent potential risk to child receptors. However, age-adjusted noncancer risks estimates are superceded by the child noncancer risk estimates.
Bolded results indicate an exceedance of U.S. EPA's target risk range of 1E-04 (1×10^{-4}) to 1E-06 (1×10^{-6}) or HI of 1.

Table 7-8
Summary of Risk Calculations - Sediment
Record of Decision
Blackbird Mine Site

Exposure Area/Receptor	Reasonable Maximum Exposure Cancer Risk	Reasonable Maximum Exposure NonCancer Hazard Index	Central Tendency Exposure Cancer Risk	Central Tendency Exposure NonCancer Hazard Index
Blackbird Mine				
Adult Worker	NC	0.02	NC	0.002
Adult Day-User	NC	5E-04	NC	5E-05
Teen Day-User	--	0.002	--	1E-04
Age-Adjusted Day-User	NC	--	NC	--
Upper Blackbird Creek				
Adult Day-User	9E-07	0.01	7E-08	0.001
Child Day-User	--	0.08	--	0.017
Age-Adjusted Day-User	5E-06	--	1E-06	--
Adult Worker	3E-06	0.02	8E-07	0.001
Lower Blackbird Creek				
Adult Day-User	2E-06	0.01	2E-07	0.003
Child Day-User	--	0.06	--	0.041
Age-Adjusted Day-User	1E-05	--	2E-06	--
West Fork Blackbird Creek				
Adult Day-User	1E-06	0.07	8E-08	0.001
Child Day-User	--	0.09	--	0.018
Age-Adjusted Day-User	6E-06	--	1E-06	--
Adult Worker	4E-06	0.03	9E-07	0.005
Bucktail Creek				
Adult Day-User	3E-07	0.00	2E-08	0.000
Teen Day-User	--	0.02	--	0.004
Age-Adjusted Day-User	2E-06	--	3E-07	--
South Fork Big Deer Creek/Big Deer Creek				
Adult Camper	1E-07	0.001	1E-08	0.0004
Child Camper	--	0.02	--	0.006
Age-Adjusted Camper	7E-07	--	2E-07	--
Adult Day-User	1E-07	0.001	1E-08	0.0004
Child Day-User	--	0.02	--	0.006
Age-Adjusted Day-User	7E-07	--	2E-07	--
Panther Creek				
Adult Day-User	1E-07	0.001	1E-08	0.0003
Child Day-User	--	0.02	--	0.004
Age-Adjusted Day-User	7E-07	--	2E-07	--

Notes:
NC = Not calculated; no Chemicals of Concern (COCs) were identified.
-- : Age-Adjusted cancer risk estimates including exposures to both adult and child receptors and are used to represent potential risk to child receptors. However, age-adjusted noncancer risks estimates are superceded by the child noncancer risk estimates.
Bolded results indicate an exceedance of U.S. EPA's target risk range of 1E-04 (1×10^{-4}) to 1E-06 (1×10^{-6}) or HI of 1.

Table 7-9
Summary of Risk Calculations - Surface Water
Record of Decision
Blackbird Mine Site

Exposure Area/Receptor	Reasonable Maximum Exposure		Central Tendency Exposure	
	Cancer Risk	NonCancer Hazard Index	Cancer Risk	NonCancer Hazard Index
Blackbird Mine				
Adult Worker	1E-05	0.07	8E-07	0.02
Adult Day-User	1E-05	0.07	8E-07	0.02
Teen Day-User	--	0.004	--	2E-04
Age-Adjusted Day-User	7E-07	--	7E-07	--
Upper Blackbird Creek				
Adult Day-User	1E-08	0.0001	9E-10	3E-05
Child Day-User	--	0.0001	--	2E-04
Age-Adjusted Day-User	2E-07	--	9E-08	--
Adult Worker	4E-08	3E-04	3E-09	5E-04
Lower Blackbird Creek				
Adult Day-User	4E-08	0.0004	8E-07	1E-04
Child Day-User	--	0.002	--	2E-03
Age-Adjusted Day-User	2E-07	--	3E-07	--
West Fork Blackbird Creek				
Adult Day-User	NC	0.009	NC	5E-04
Child Day-User	--	0.002	--	0.002
Age-Adjusted Day-User	NC	--	NC	--
Adult Worker	NC	0.002	NC	5E-04
Bucktail Creek				
Adult Day-User	1E-08	4E-04	1E-09	9E-05
Teen Day-User	--	0.002	--	7E-05
Age-Adjusted Day-User	2E-07	--	1E-07	--
South Fork Big Deer Creek/Big Deer Creek				
Adult Camper	-- NC : no COCs identified --			
Child Camper				
Age-Adjusted Camper				
Adult Camper				
Child Camper				
Age-Adjusted Camper				
Panther Creek				
Adult Day-User	-- NC : no COCs identified --			
Child Day-User				
Age-Adjusted Day-User				

Notes:
NC = Not calculated; no Chemicals of Concern (COCs) were identified.
-- : Age-Adjusted cancer risk estimates including exposures to both adult and child receptors and are used to represent potenti
risk to child receptors. However, age-adjusted noncancer risks estimates are superceded by the child noncancer risk estimate
Bolded results indicate an exceedance of U.S. EPA's target risk range of 1E-04 (1×10^{-4}) to 1E-06 (1×10^{-6}) or HI of 1.

Table 7-10
Summary of Cumulative Risk Assessments Results (Surface Soil/Mine Wastes, Sediment, and Surface Water)
Record of Decision
Blackbird Mine Site

Exposure Scenario/ Receptor	Reasonable Maximum Exposure Cancer Risk	Reasonable Maximum Exposure NonCancer Hazard Index	Central Tendency Exposure Cancer Risk	Central Tendency Exposure NonCancer Hazard Index
Blackbird Mine				
Adult Worker	4E-05	0.3	7E-06	0.1
Adult Day-User	1E-05	0.08	2E-06	0.02
Teen Day-User	--	0.02	--	8E-04
Age-Adjusted Day-User	1E-05	--	2E-06	--
Upper Blackbird Creek				
Adult Day-User	1E-05	0.1	8E-07	0.0
Child Day-User	--	0.7	--	0.2
Age-Adjusted Day-User	3E-05	--	6E-06	--
Adult Worker	1E-05	0.1	2E-06	0.03
Lower Blackbird Creek				
Adult Day-User	9E-06	0.1	1E-06	0.03
Child Day-User	--	0.7	--	0.2
Age-Adjusted Day-User	3E-05	--	8E-06	--
West Fork Blackbird Creek				
Adult Day-User	5E-06	0.1	3E-07	0.01
Child Day-User	--	0.6	--	0.1
Age-Adjusted Day-User	3E-05	--	4E-06	--
Adult Worker	7E-06	0.1	2E-06	0.0
Bucktail Creek				
Adult Day-User	2E-06	0.01	3E-07	0.00
Child Day-User	--	0.03	--	0.0
Age-Adjusted Day-User	7E-06	--	1E-06	--
South Fork Big Deer Creek/Big Deer Creek				
Adult Camper	3E-06	0.03	6E-07	0.003
Child Camper	--	0.3	--	0.04
Age-Adjusted Camper	4E-06	--	2E-06	--
Adult Day-User	5E-07	0.006	5E-08	0.002
Child Day-User	--	0.1	--	0.02
Age-Adjusted Day-User	2E-06	--	4E-07	--
Panther Creek (Sediment and Surface Water Only)				
Adult Day-User	1E-07	0.001	1E-08	3E-04
Child Day-User	--	0.02	--	0.004
Age-Adjusted Day-User	7E-07	--	2E-07	--

Notes:
NC = Not calculated; no Chemicals of Concern (COCs) were identified.
-- : Age-Adjusted cancer risk estimates including exposures to both adult and child receptors and are used to represent potential risk to child receptors. However, age-adjusted noncancer risks estimates are superceded by the child noncancer risk estimates.
Bolded results indicate an exceedance of U.S. EPA's target risk range of 1E-04 (1×10^{-4}) to 1E-06 (1×10^{-6}) or HI of 1.

TABLE 8-2
Recreational Exposure Factors
Blackbird Mine Site

Symbol	Definition (units)	Day-User at Upper Blackbird Creek	Day-User at Lower Blackbird Creek
TR	Target Risk	1×10^{-4}	1×10^{-4}
THI	Target Hazard Index	1	1
Atc	Averaging Time –cancer (days)	25,550	25,550
Atnc	Averaging Time – noncancer (days)	2,190	2,190
BW	Body Weight – Child (kg)	15	15
EF	Exposure Frequency (days/year)	7	14
ET	Exposure Time (hours/day)	2	2
ED	Exposure Duration – child (years)	6	6
Irs	Ingestion Rate – child (mg/day)	300	300
Iradj	Ingestion Rate – age-adjusted (mg-yr/kg-d)	154	154
FI	Fraction Ingested (unitless)	1	1
CF	Conversion Factor (kg/mg)	1×10^{-6}	1×10^{-6}
BAF	Bioavailability Factor (unitless)	0.6	0.6
InhRadj	Air Inhalation Rate – age-adjusted (m^3-yr/kg-day)	11	11
InhRchild	Air Inhalation Rate – child (m^3/day)	10	10
1/PEF	1/Particulate Emission Factor (kg/m^3)	7.6×10^{-10}	7.6×10^{-10}
SCF	Skin Contact Factor-age-adjusted (mg-yr/kg-day)	341	341
Sachild	Skin Surface Area – child (cm^2/day)	2,200	2,200
BAF	Bioavailability Factor – arsenic	0.60	0.60
ABS	Absorption Factor (unitless)	0.03	0.03
AF	Adherence Factor - child (mg/cm^2)	0.2	0.2

TABLE 10-1
Evaluation Summary for Blackbird Creek Alternatives

Alternative / Criteria	BB-1	BB-4	BB-5	BB-6	BB-7	BB-8
	No Further Action	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments	Meadow Creek Seep Collection; Cap Tailings Impoundment and Treat Tailings Impoundment Seepage; Complete Removal of Overbank Deposits and In-Stream Sediments
Overall Protection	Not protective of human health or the environment	Protective of human health. May periodically exceed water quality cleanup goals in Panther Creek. Stabilization of overbank deposits may not provide as good overall protection as alternatives that include more removal.	Protective of human health. May periodically exceed copper and cobalt cleanup goals in Panther Creek. Stabilization of overbank deposits may not provide as good overall protection as alternatives that include more removal.	Protective of human health. Meets copper cleanup goals in Panther Creek. Uncertainty in terms of meeting cobalt cleanup goals in Panther Creek, and would require years to decades. Removal of overbank deposits likely to provide better overall protection than alternatives that rely primarily on stabilization.	Protective of human health and the environment. Meets copper and cobalt cleanup goals in Panther Creek. Removal of overbank deposits likely to provide better overall protection than alternatives that rely primarily on stabilization.	Protective of human health and the environment in long-term. Meets copper and cobalt cleanup goals in Panther Creek. This alternative would result in signficant short-term impacts to the environment with no significant improvements to water quality.
Compliance with ARARs	Currently does not consistently meet copper water quality standard in Panther Creek. Meets all other ARARs.	Periodic exceedance of copper water quality standard in Panther Creek likely. Maximum mixing zone of 48% for copper and 100% for cobalt in Panther Creek (average conditions). Meets all other ARARs	Occasional springtime exceedance of copper water quality standard in Panther Creek likely. Maximum mixing zone of 48% for copper and 85% for cobalt in Panther Creek (average conditions) Meets all other ARARs.	Expected to consistently achieve copper water quality standard in Panther Creek. Maximum mixing zone of 30% for copper and 100% for cobalt in Panther Creek (average conditions) Meets all other ARARs	Expected to consistently achieve copper water quality standard in Panther Creek. Maximum mixing zone of 30% for copper and 70% for cobalt in Panther Creek (average conditions) Meets all other ARARs	Expected to consistently achieve copper water quality standard in Panther Creek. Maximum mixing zone of 30% for copper and 65% for cobalt in Panther Creek (average conditions) Meets all other ARARs
Long-Term Effectiveness	Does not consistently meet water quality cleanup goals. Existing controls inadequate to protect against residual risks. Not effective in long-term	Not expected to consistently achieve water quality objectives. Capping at West Fork Impoundment not as reliable or certain as treatment for meeting cobalt cleanup goal in Panther Creek. Physical stabilization not as reliable as removal for overbank deposits.	Not expected to consistently achieve water quality objectives. Treatment at West Fork Impoundment more reliable and certain than capping for meeting cobalt cleanup goal in Panther Creek. Physical stabilization not as reliable as removal for overbank deposits.	Not expected to consistently achieve water quality objectives. Expected to meet copper cleanup goal in Panther Creek; capping at West Fork Impoundment not as reliable or certain as treatment for meeting cobalt cleanup goal in Panther Creek. Removal of overbank deposits more effective and reliable than physical stabilization.	Expected to consistently achieve water quality objectives. Treatment at West Fork Impoundment more reliable and certain than capping for meeting cobalt cleanup goal in Panther Creek. Removal of overbank deposits more effective and reliable than physical stabilization.	Expected to consistently achieve water quality objectives. Treatment at West Fork Impoundment more reliable and certain than capping for meeting cobalt cleanup goal in Panther Creek. Removal of all in-stream and overbank deposits most reliable in long-term.
Reduction in Toxicity, Mobility, Volume Through Treatment	No additional treatment provided	Treatment of Meadow Creek seepage	Treatment of Meadow Creek seepage and Tailings Impoundment seepage	Treatment of Meadow Creek seepage	Treatment of Meadow Creek seepage and Tailings Impoundment seepage	Treatment of Meadow Creek seepage and Tailings Impoundment seepage
Short-Term Effectiveness	Does not create the short-term construction risks	Short-term construction risks similar for Alternatives BB-4 through BB-7.	Short-term construction risks similar for Alternatives BB-4 through BB-7.	Short-term construction risks similar for Alternatives BB-4 through BB-7. May require years to a decade or more to achieve cobalt cleanup goals in Panther Creek.	Short-term construction risks similar for Alternatives BB-4 through BB-7. Would meet all cleanup goals within 1 to 2 years after implementation.	Extensive short-term environmental impacts for up to a decade until riparian vegetation recovers. Would require greatest time to implement (3 or more years).
Implementability	No implementation required	Readily implemented. Physical stabilization more difficult than removal because large riprap difficult to locate. Capping at West Fork less difficult than treatment.	Readily implemented. Physical stabilization more difficult than removal because large riprap difficult to locate. Treatment at West Fork more difficult than capping.	Readily implemented; less difficult than all other alternatives except No Further Action	Readily implemented. Treatment at West Fork more difficult than capping.	Very difficult to implement. Would require extensive sediment controls and excavation below the water table. Would require siting of new disposal facility.
Cost (millions, net present value)	$1.2	$4.2	$6.4 to $9.9 (a)	$4.6	$6.8 to $10.2 (a)	$52.7 to $56.2 (a)

(a) Costs depend on treatment option for groundwater at the West Fork Tailings Impoundment (see Table 10-4 and Tables 12-1 through 12-3 for details)

TABLE 10-2
Evaluation Summary for Bucktail Creek Alternatives

Alternative / Criteria	BT-1 No Further Action	BT-3 Seep Collection and Treatment; Natural Recovery of Sediments	BT-4 Seep Collection and Treatment; S. Fork Big Deer Creek Sediment Removal; Natural Recovery of Remaining Sediments	BT-5 Seep Collection and Treatment; Diversion of Bucktail Creek; Natural Recovery of Sediments	BT-6 Seep Collection and Treatment; Complete Sediment Removal
Overall Protection	Protective of human health. Would not meet water quality cleanup goals in South Fork or Big Deer Creeks.	Protective of human health. Would meet cleanup goals in Big Deer Creek. Would not meet cleanup goals in So. Fork Big Deer Creek.	Protective of human health. Would meet cleanup goals Big Deer Creek, but not in South Fork. Removal of sediments in So. Fork would not significantly improve time to meet cleanup goals in So. Fork Big Deer Creek.	Protective of human health. Would meet cleanup goals in Big Deer Creek. Diversion of Bucktail Creek would allow cleanup goals to be met in So. Fork Big Deer Creek.	Protective of human health. Would meet cleanup goals Big Deer Creek, but not in South Fork. Removal of all sediments would result in significant short-term impacts to the environment.
Compliance with ARARs	Would not meet copper ARAR in South Fork or Big Deer Creeks. Meets all other ARARs	Would meet copper water quality ARAR in Big Deer Creek, but not in South Fork Creek. Maximum mixing zone for copper in Big Deer Creek is 70 to 100% (average conditions), depending on effectiveness of Bucktail seep collection. Meets all other ARARs	Would meet copper water quality ARAR in Big Deer Creek, but not in South Fork Creek. Maximum mixing zone for copper in Big Deer Creek is 70 to 100% (average conditions), depending on effectiveness of Bucktail seep collection. Meets all other ARARs	Would meet copper ARAR in both South Fork and Big Deer Creeks. Maximum mixing zone for copper in Big Deer Creek is 70 to 100% (average conditions), depending on effectiveness of Bucktail seep collection. Meets all other ARARs	Would meet copper water quality ARAR in Big Deer Creek, but not in South Fork Creek. Maximum mixing zone for copper in Big Deer Creek is 70 to 100% (average conditions), depending on effectiveness of Bucktail seep collection. Meets all other ARARs
Long-Term Effectiveness	Not effective or reliable in long term.	Would be effective and reliable in long-term for meeting cleanup goals in Big Deer Creek. Would not meet cleanup goals in South Fork.	Would be effective and reliable in long-term for meeting cleanup goals in Big Deer Creek. Would not meet cleanup goals in South Fork. Bucktail Creek sediments or water could recontaminate the replacement South Fork sediments.	Would be effective and reliable in long-term for meeting cleanup goals in both South Fork and Big Deer Creeks.	Would be effective and reliable in long-term for meeting cleanup goals in Big Deer Creek. Would not meet cleanup goals in South Fork. Bucktail Creek sediments or water could recontaminate the replacement South Fork and Big Deer Creek sediments.
Reduction in Toxicity, Mobility, Volume Through Treatment	No additional treatment provided	Treatment of Bucktail seepage	Treatment of Bucktail seepage	Treatment of Bucktail seepage	Treatment of Bucktail seepage
Short-Term Effectiveness	Does not create the short-term construction risks	Flushing of Bucktail Creek sediments may result in exceedances of cleanup goals in Big Deer Creek until the sediments are flushed (a). There would be some short term construction risks for seepage collection system.	Flushing of Bucktail Creek sediments may result in exceedances of cleanup goals in Big Deer Creek until the sediments are flushed (a). Short term construction risks would be increased to remove sediments from So. Fork Big Deer Creek.	Flushing of Bucktail Creek sediments may result in exceedances of cleanup goals in Big Deer Creek until the sediments are flushed (a). cleanup goals should be met in South Fork within 2-5 years. There would be some short term construction risks for seepage collection system.	Would meet cleanup goals in Big Deer within 1-2 years of completion. Would not meet cleanup goals in South Fork. Would require 3 to 5 years for construction. Extensive short-term construction impacts to stream channels and riparian vegetation would require decade or more for recovery
Implementability	No implementation required	There will be some technical challenges intercepting sufficient seepage to meet cleanup goals.	Difficult to implement. Would require extensive sediment controls and excavation below the water table in South Fork. There will be some technical challenges intercepting sufficient seepage to meet cleanup goals.	There will be some technical challenges intercepting sufficient seepage to meet cleanup goals.	Very difficult to implement. Would require extensive sediment controls and excavation below the water table. There will be some technical challenges intercepting sufficient seepage to meet cleanup goals. Would require siting of new disposal facility.
Cost (millions, net present value)	$1.2	$4.4	$5.0	$4.7	$11.3

(a) The timing for Bucktail Creek sediment flushing is uncertain, but may be years to a decade or more. If water quality cleanup goals are not consistently met in Big Deer Creek in an acceptable time frame, alternatives for contingencies to address water quality will be evaluated.

TABLE 10-3
Evaluation Summary for Panther Creek Alternatives

Alternative / Criteria	P-1 No Further Action	P-2 Natural Recovery with Institutional Controls and Monitoring	P-3 Selective Overbank Deposit Removal
Overall Protection	Not guaranteed	Overall protection relies on effectiveness of institutional controls and monitoring	Removal of deposits exceeding human health PRGs ensures overall protectiveness
Compliance with ARARs	Yes	Yes	Yes
Long-Term Effectiveness	Potential unacceptable risk under future residential land use scenario.	Effective and reliable for current and future land uses if institutional controls are maintained.	Effective and reliable for current and future land uses.
Reduction in Toxicity, Mobility, Volume Through Treatment	None	None	None
Short-Term Effectiveness	Does not create the short-term risks of Alternative P-3.	Does not create the short-term risks of Alternative P-3.	Removal creates potential short-term risks to the community, site workers, and the environment during implementation.
Implementability	No implementation required	Implementable as long as an appropriate entity is willing to serve as grantee of the land restriction instrument(s) and private property owners are willing to accept ICs.	Readily implemented
Cost (millions, net present value)	$0.0	$0.4	$1.6

NOTE: Water quality improvements in Panther Creek determined by alternatives selected for Blackbird Creek and for Bucktail Creek.

TABLE 10-4
SUMMARY OF ESTIMATED ALTERNATIVE COSTS

Alternative		Estimated Costs (millions) [a]		
		Capital	Annual [b]	Total
Blackbird Creek (incl. Tailings Impoundment)				
BB-1	No Further Action	$0.0	$1.2	$1.2
BB-4	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments	$2.1	$2.0	$4.2
BB-5	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments			
a	Treat Tailings Impoundment Seepage with Passive In-Situ	$3.2	$3.2	$6.4
b	Treat Tailings Impoundment Seepage with Active In-Situ	$4.7	$4.8	$9.5
c	Treat Tailings Impoundment Seepage at WTP	$5.3	$4.5	$9.9
BB-6	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments	$2.7	$1.9	$4.6
BB-7	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments			
a	Treat Tailings Impoundment Seepage with Passive In-Situ	$3.7	$3.0	$6.8
b	Treat Tailings Impoundment Seepage with Active In-Situ	$5.2	$4.7	$9.9
c	Treat Tailings Impoundment Seepage at WTP	$5.9	$4.4	$10.2
BB-8	Meadow Creek Seep Collection; Cap West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Complete Removal of Overbank Deposits and In-Stream Sediments			
a	Treat Tailings Impoundment Seepage with Passive In-Situ	$49.1	$3.7	$52.7
b	Treat Tailings Impoundment Seepage with Active In-Situ	$50.5	$5.3	$55.8
c	Treat Tailings Impoundment Seepage at WTP	$51.2	$5.0	$56.2
Bucktail, S. Fork Big Deer, and Big Deer Creeks				
BT-1	No Further Action	$0.0	$1.2	$1.2
BT-3	Seep Collection and Treatment; Natural Recovery of Sediments	$2.0	$2.4	$4.4
BT-4	Seep Collection and Treatment; S. Fork Big Deer Creek Sediment Removal; Natural Recovery of Remaining Sediments	$2.6	$2.4	$5.0
BT-5	Seep Collection and Treatment; Diversion of Bucktail Creek; Natural Recovery of Sediments	$2.3	$2.4	$4.7
BT-6	Seep Collection and Treatment; Complete Sediment Removal	$8.4	$2.9	$11.3
Panther Creek				
P-1	No Further Action	$0.0	$0.0	$0.0
P-2	Natural Recovery with Institutional Controls and Monitoring	$0.1	$0.3	$0.4
P-3	Selective Overbank Deposit Removal; Natural Recovery of In-Stream Sediments	$1.4	$0.2	$1.6

[a] Costs are for early 2002.

[b] Net present value of future costs (O&M monitoring) at 7% discount rate for 30 years.

Table 10-4.xls, Cost Summ After Golder Associates

TABLE 12-1
ESTIMATED COST FOR ALTERNATIVE BB-7a

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Collect Meadow Creek seeps				$116,000	See FS Table E-18
Tailings Impoundment soil cover - grading	11.4	ac	$5,000	$57,000	Material already placed
Revegetation for soil cover	11.4	ac	$2,000	$22,800	Impoundment area less creek channel
Treatment of Tailings Impoundment seepage				$802,000	In-situ sorption; 50% removal; FS Table E-22
Armoring of overbank deposits	2,900	cy	$40	$116,000	Vol. estimated from FS Chapter 6 figures
Removal of selected overbank deposits	37,000	cy	$20	$740,000	Vol. estimated from FS Chapter 6 figures
Armoring residual above human health PRG	1,000	cy	$40	$40,000	Allowance
Channel for Blackbird Creek near PCI				$29,000	See FS Table E-23
Establish institutional controls				$50,000	Allowance
Subtotal				$1,972,800	
Contractor overhead and profit			20%	$395,000	
Engineering and construction surveillance			25%	$493,000	
Agency oversight			10%	$197,000	
Project management and legal			10%	$197,000	
Contingency			25%	$493,000	
TOTAL CAPITAL COSTS				**$3,747,800**	
OPERATIONS AND MAINTENANCE COSTS				Present value calculation, 7% net interest	
Tailings Impoundment soil cover maintenance	30	yr	$4,000	$50,000	Allowance
Meadow Creek treatment	30	yr	$20,000	$248,000	Diversion option; see FS Table E-18
Tailings Impoundment seepage treatment	30	yr	$67,000	$831,000	See FS Table E-22
Inspection and monitoring of armoring	30	yr	$10,000	$124,000	Allowance
Maintenance of existing fencing	30	yr	$1,000	$12,000	Allowance
Sediment cleanout of Blackbird channel near PCI	30	yr	$4,000	$50,000	Allowance for infrequent event
Monitoring and reporting (see Table E-29)	30	yr		$850,000	Present value cost of cash flow
Subtotal				$2,165,000	
Project management			5%	$108,000	
Agency oversight			10%	$217,000	
Contingency			25%	$541,000	
NET PRESENT VALUE O&M COST				**$3,031,000**	
TOTAL ALTERNATIVE COST				**$6,778,800**	Net present value [b]

[a] Costs are for early 2002. Costs do not included current O&M costs.

[b] The sum of capital costs and the net present value of long-term O&M costs.

TABLE 12-2
ESTIMATED COST FOR ALTERNATIVE BB-7b

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Collect Meadow Creek seeps				$116,000	See FS Table E-18
Tailings Impoundment soil cover - grading	11.4	ac	$5,000	$57,000	Material already placed
Revegetation for soil cover	11.4	ac	$2,000	$22,800	Impoundment area less creek channel
Treatment of Tailings Impoundment seepage				$1,570,000	In-situ package treatment plant; See FS Table E-21
Armoring of overbank deposits	2,900	cy	$40	$116,000	Vol. estimated from FS Chapter 6 figures
Removal of selected overbank deposits	37,000	cy	$20	$740,000	Vol. estimated from FS Chapter 6 figures
Armoring residual above human health PRG	1,000	cy	$40	$40,000	Allowance
Channel for Blackbird Creek near PCI				$29,000	See FS Table E-23
Establish institutional controls				$50,000	Allowance
Subtotal				$2,740,800	
Contractor overhead and profit			20%	$548,000	
Engineering and construction surveillance			25%	$685,000	
Agency oversight			10%	$274,000	
Project management and legal			10%	$274,000	
Contingency			25%	$685,000	
TOTAL CAPITAL COSTS				**$5,206,800**	
OPERATIONS AND MAINTENANCE COSTS				Present value calculation, 7% net interest	
Tailings Impoundment soil cover maintenance	30	yr	$4,000	$50,000	Allowance
Meadow Creek treatment	30	yr	$20,000	$248,000	Diversion option; see FS Table E-18
Tailings Impoundment seepage treatment	30	yr	$161,000	$1,998,000	See FS Table E-20
Inspection and monitoring of armoring	30	yr	$10,000	$124,000	Allowance
Maintenance of existing fencing	30	yr	$1,000	$12,000	Allowance
Sediment cleanout of Blackbird channel near PCI	30	yr	$4,000	$50,000	Allowance for infrequent event
Monitoring and reporting (see Table E-29)	30	yr		$850,000	Present value cost of cash flow
Subtotal				$3,332,000	
Project management			5%	$167,000	
Agency oversight			10%	$333,000	
Contingency			25%	$833,000	
NET PRESENT VALUE O&M COST				**$4,665,000**	
TOTAL ALTERNATIVE COST				**$9,871,800**	Net present value [b]

[a] Costs are for early 2002. Costs do not included current O&M costs.

[b] The sum of capital costs and the net present value of long-term O&M costs.

TABLE 12-3
ESTIMATED COSTS FOR ALTERNATIVE BB-7c

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Collect Meadow Creek seeps				$116,000	See FS Table E-18
Tailings Impoundment soil cover - grading	11.4	ac	$5,000	$57,000	Material already placed
Revegetation for soil cover	11.4	ac	$2,000	$22,800	Impoundment area less creek channel
Treatment of Tailings Impoundment seepage				$1,920,000	Pump to WTP; 80% removal; FS Table E-20
Armoring of overbank deposits	2,900	cy	$40	$116,000	Vol. estimated from FS Chapter 6 figures
Removal of selected overbank deposits	37,000	cy	$20	$740,000	Vol. estimated from FS Chapter 6 figures
Armoring residual above human health PRG	1,000	cy	$40	$40,000	Allowance
Channel for Blackbird Creek near PCI				$29,000	See FS Table E-23
Establish institutional controls				$50,000	Allowance
Subtotal				$3,090,800	
Contractor overhead and profit			20%	$618,000	
Engineering and construction surveillance			25%	$773,000	
Agency oversight			10%	$309,000	
Project management and legal			10%	$309,000	
Contingency			25%	$773,000	
TOTAL CAPITAL COSTS				**$5,872,800**	
OPERATIONS AND MAINTENANCE COSTS				Present value calculation, 7% net interest	
Tailings Impoundment soil cover maintenance	30	yr	$4,000	$50,000	Allowance
Meadow Creek treatment	30	yr	$20,000	$248,000	Diversion option; see FS Table E-18
Tailings Impoundment seepage treatment	30	yr	$144,000	$1,787,000	See FS Table E-20
Inspection and monitoring of armoring	30	yr	$10,000	$124,000	Allowance
Maintenance of existing fencing	30	yr	$1,000	$12,000	Allowance
Sediment cleanout of Blackbird channel near PCI	30	yr	$4,000	$50,000	Allowance for infrequent event
Monitoring and reporting (see Table E-29)	30	yr		$850,000	Present value cost of cash flow
Subtotal				$3,121,000	
Project management			5%	$156,000	
Agency oversight			10%	$312,000	
Contingency			25%	$780,000	
NET PRESENT VALUE O&M COST				**$4,369,000**	
TOTAL ALTERNATIVE COST				**$10,241,800**	Net present value [b]

[a] Costs are for early 2002. Costs do not included current O&M costs.

[b] The sum of capital costs and the net present value of long-term O&M costs.

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TABLE 12-4
ESTIMATED COST FOR ALTERNATIVE BT-5

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Collection and treatment of Bucktail Creek seeps				$190,000	Phase 1; see FS Table E-24
Collection and treatment of Bucktail Creek seeps				$879,000	Phase 2; see FS Table E-25
Divert Bucktail Creek directly to Big Deer Creek	3,400	lf	$45	$153,000	24-inch HDPE pipe
Flow Splitter				$10,000	Estimate
Diffuser				$30,000	Discharge into Big Deer Creek
Subtotal				$1,222,000	
Contractor overhead and profit			20%	$244,000	
Engineering and construction surveillance			25%	$306,000	
Agency oversight			10%	$122,000	
Project management and legal			10%	$122,000	
Contingency			25%	$306,000	
TOTAL CAPITAL COSTS				**$2,322,000**	
OPERATIONS AND MAINTENANCE COSTS				Present value calculation, 7% net interest	
Collection and treatment of Bucktail Creek seeps	30	yr	$39,000	$484,000	Phase 1; see FS Table E-24
Collection and treatment of Bucktail Creek seeps	30	yr	$25,000	$310,000	Phase 2; see FS Table E-25
Sediment dam maintenance or removal				$50,000	Allowance
Monitoring and reporting (see Table E-29)	30	yr		$850,000	Present value cost of cash flow
Subtotal				$1,694,000	
Project management			5%	$85,000	
Agency oversight			10%	$169,000	
Contingency			25%	$424,000	
NET PRESENT VALUE O&M COST				**$2,372,000**	
TOTAL ALTERNATIVE COST				**$4,694,000**	Net present value [b]

[a] Costs are for early 2002. Costs do not included current O&M costs.

[b] The sum of capital costs and the net present value of long-term O&M costs.

Table 12-4.xls, Alt_BT5

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TABLE 12-5
ESTIMATED COST FOR COMBINED ALTERNATIVES P-2/P-3

Item		Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS						
Establish instutional controls					$40,000	Allowance
Selective removal - R(b)		800		$50	$40,000	Vol. estimated from FS Chapter 6 figures
Selective removal - S(b)		300		$50	$15,000	Vol. estimated from FS Chapter 6 figures
	Subtotal	1,100			$95,000	
Contractor overhead and profit				20%	$19,000	
Engineering and construction surveillance				25%	$24,000	
Agency oversight				10%	$10,000	
Project management and legal				10%	$10,000	
Contingency				25%	$24,000	
TOTAL CAPITAL COSTS					**$182,000**	
OPERATIONS AND MAINTENANCE COSTS						
Institutional controls monitoring (allowance)		30	yr	$5,000	$62,000	Present value cost of cash flow
Monitoring and reporting (see Table E-29)		30	yr	$10,000	$124,000	Present value cost of cash flow
	Subtotal				$186,000	
Project management				5%	$9,000	
Agency oversight				10%	$19,000	
Contingency				25%	$47,000	
NET PRESENT VALUE O&M COST					**$261,000**	
TOTAL ALTERNATIVE COST					**$443,000**	Net present value [b]

[a] Costs are for early 2002.

[b] The sum of capital costs and the net present value of long-term O&M costs.

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2/03/.

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

IDAHO OPERATIONS OFFICE
3 7 2003

900 North Skyline, Suite B • Idaho Falls, Idaho 83402-1718 • (208) 528-2650

Dirk Kempthorne, Governor
C. Stephen Allred, Director

February 3, 2003

Ms. Fran Allans
U. S. Environmental Protection Agency
1435 N. Orchard
Boise, Idaho 83706

Re: State Concurrence with EPA's Record of Decision for the Blackbird Mine

Dear Ms. Allans:

This correspondence is in response to your letter dated January 9, 2003, enclosing the final Record of Decision ("ROD") for the Blackbird Mine site. In that letter you requested the state's concurrence on the selected remedy outlined in the enclosed ROD, as required by Section 300.515 of the National Contingency Plan. The State concurs with the selected remedy contained in the ROD subject to the states' comments previously provided to EPA's Proposed Plan.

In the absence of specific numeric water quality criteria, Idaho Code seeks to ensure all surface waters fully support beneficial uses. Idaho Water Quality Standards 58.0102.200 states, "Surface waters shall be free from toxic substances in concentrations that impair designated beneficial uses". This standard is applicable to the surface water cleanup levels for cobalt, as well as all the sediment cleanup targets. The State concurs that these cleanup levels will likely be protective of beneficial uses. Even though we concur that the surface water cobalt cleanup level is adequately protective, we also note that there was considerable uncertainty in its derivation. The State continues to support chronic toxicity testing with cobalt prior to implementing large-scale actions to meet the current cobalt cleanup level. We think it probable, that if high quality chronic aquatic toxicity testing with cobalt were completed, a different cobalt cleanup level would likely result.

The question of transporting Bucktail Creek water around the South Fork of Big Deer Creek contained in alternative BT-5 remains at issue. It is uncertain if this action will result in the necessary improvements in water quality in South Fork Big Deer Creek. In order to keep all options open, the State would prefer to first judge the effectiveness of the Bucktail Creek Seep collection before determining a course of action involving any rerouting of Bucktail Creek. This effectiveness evaluation will help determine what additional contingency efforts are needed in conjunction with various aspects of BT-5 to reduce copper loading to Big Deer Creek.

Thank you for all of your efforts towards reaching final remediation of this site.
If you have any further concerns, please do not hesitate to contact either Elton Modroo or myself at 208-528-2650.

Sincerely

James Johnston
Regional Administrator
Department of Environmental Quality

cc: D. Mabe, DEQ
N. Krema, AG-ID
P. Peters, USFS
N. Iadanza, NMFS
E. Modroo, DEQ
T. Saffle, DEQ
R. Jacobson, USDOJ
S. Shutler, NOAA
S. White, USDA

United States Department of Agriculture
Forest Service
Intermountain Region
324 25th Street
Ogden, UT 84401
801-625-5605

File Code: 2160/2800
Date: FEB 0 3 2003

Ms. Fran Allans, Remedial Project Manager
U.S. Environmental Protection Agency, Region X
1435 North Orchard Street
Boise, ID 83706

Dear Ms. Allans:

The Intermountain Region of the Forest Service concurs on the January 8 Draft Final Record of Decision (ROD) for the Blackbird Mine Site in Idaho. This concurrence covers the Environmental Protection Agency's (EPA) selection of alternatives BB-7, BT-5, and a combination of P-2 and P-3. The Forest Service fully supports the goals of restoring and maintaining water quality and appropriate resident and anadromous fisheries in the Big Deer and Panther Creeks.

The Forest Service recommends that the EPA consider the following during implementation of the selected alternatives:

1. Phase in the remedy in the Bucktail Creek drainage due to the uncertainties associated with the selected remedy and the unknown effectiveness of the construction work performed in 2002. This will involve monitoring as the work progresses and potentially modifying future work plans based on the monitoring results. Specifically phase and evaluate the work to determine if the proposed pipeline is necessary and adequate.

2. EPA will coordinate with the Forest Service on any road construction or other surface disturbance necessary in the West Panther Creek Roadless Area to implement the remedy. Construction activities are generally prohibited in Roadless Areas; however, such activities conducted as part of a Comprehensive Environmental Response Compensation and Liability Act (CERCLA) action may be allowed (36 CFR 294.12(b)(2)).

3. Continue consultation with the National Marine Fisheries Service and the Fish and Wildlife Service to address their concerns that actions related to this project are likely to adversely affect the Chinook salmon and bull trout and their critical habitat.

4. Review the technical and clerical comments enclosed and include where appropriate.

If you have questions, please contact Suzanne Buntrock, CERCLA Coordinator, or Pete Peters, On-Scene Coordinator, at (801) 625-5454 or (208) 879-4158, respectively.

Sincerely,

Bert Kulesza

for JACK G. TROYER
Regional Forester

Enclosures

APPENDIX D
PART III: RESPONSIVENESS SUMMARY
BLACKBIRD MINE
SUPERFUND SITE

The responsiveness summary addresses public comments received on the Proposed Plan for the Blackbird Mine Site. The public comment period on the Proposed Plan was held from August 26, 2002 to October 10, 2002. A public meeting was not held because of security concerns. Additional information on the community involvement for this site is discussed in Section 3 of the ROD.

OVERVIEW

The U.S. Environmental Protection Agency (EPA) distributed a Proposed Plan for remedial action at the Blackbird Mine site in Lemhi County, Idaho. The Proposed Plan identified the preferred remedial alternative for the site. The major components of the proposed remedial alternative for the Blackbird Mine presented in the Proposed Plan were as follows:

- **Blackbird Creek Drainage Area:** Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-stream Sediments.

- **Bucktail Creek Drainage Area:** Seep Collection and Treatment; Diversion of Bucktail Creek; Natural Recovery of In-stream Sediments

- **Panther Creek Drainage Area:** Combination of Removal of Arsenic Contaminated Soil Along the Banks of Panther Creek and Institutional Controls (if accepted by the current property Owner and a grantee can be obtained). Natural Recovery of In-stream Sediments.

EPA received eight written comments during the public comment period from August 26, 2002 to October 10, 2002 and one comment on November 22, 2002 after the end of the public comment period. The comments and responses are provided below.

Comments from Blackbird Mine Site Group (BMSG) Volume I, Exhibits C and G

Comment 1: *In 1995, the BMSG, the United States and the State of Idaho entered into a Consent Decree that established a goal of reducing copper concentrations to a level sufficient to protect all life stages of salmonids in Panther Creek and Big Deer Creek downstream of the site. In the absence of a Record of Decision (ROD) for the Blackbird Mine, and to expedite cleanup, the parties agreed on a presumptive remedy, called an "Early Action." The Early Action was initiated by the BMSG pursuant to a 1995 EPA Administrative Order on Consent, with the approval of the Trustees. The Early Action was designed to achieve the Consent Decree goal of reducing copper concentrations sufficient to protect all life stages of salmonids in Panther Creek and Big Deer Creek downstream of the site. EPA subsequently required additional removal actions along the banks of Panther Creek and Blackbird Creek, with the result that cleanup* *action has been performed every year since 1995. More than $63 million has been spent to date by the BMSG pursuant to the 1995 Consent Decree and Administrative Order for the performance of Early Action.*

Response 1: The BMSG's comment mischaracterizes the purpose and scope of 1995 Consent Decree and the Administrative Orders. The 1995 Consent Decree established a natural resource restoration goal for copper and expressly stated that it did not establish a cleanup goal for the purposes of remedy selection. (See response to Comment 13.) Further, the "Early Actions" performed pursuant to the Administrative Orders were removal actions (not presumptive remedies) designed to make progress toward meeting both the NRD goals and the cleanup goals for this Site.

Comment 2: *Although it may take several years for the full benefits of the Early Action to be seen, the remedial actions performed to date already appear to be sufficient to meet Consent Decree goals in Panther Creek. Several fish species occur in abundance in Panther Creek, including all life stages of salmonids, with no negative effects in terms of reduced abundance, biomass or condition downstream of Blackbird Creek or Big Deer Creek. In Big Deer Creek, there is evidence of fish recolonization. Continued improvements in fish and macroinvertebrate populations are expected to occur without further action at the site. Despite this success, EPA has insisted on proceeding with a Remedial Investigation (RI) and Feasibility Study (FS) and has proposed that further remedial actions be performed at the Blackbird Mine.*

Response 2: It is important to recognize that the standards that EPA is required to apply to selection of a remedial action differ from the NRD goals established in the 1995 Consent Decree. CERCLA establishes specific criteria that must be met in selecting a remedy. Pursuant to Section 121 of CERCLA, the remedy must be protective of human health and the environment and must comply with all applicable and relevant or appropriate requirements (ARARs). Measuring fish populations and macroinvertbrates is one factor in the evaluation to determine if the remedy is protective of the environment. However, there are other aspects of environmental and human health exposures that must also be evaluated to determine if the remedy is protective. The quality of the water for all contaminants of concern is an important measurement of the protectiveness of a remedy as well as a required measurement for compliance with ARARs. Protection of human health and the environment and compliance with ARARS are mandatory standards that must be achieved by the selected remedy. There are also a number of additional criteria that must be balanced in selecting the remedy. The Consent Decree expressly recognized the applicability of these standards to EPA's remedy selection process. (See response to BMSG Comment 13.)

EPA has numerous concerns regarding the fish study presented in Exhibit C of the BMSG's comments. First, the BMSG failed to follow the protocols established in the Administrative Order on Consent and the National Contingency Plan (NCP) regarding agency review and approval of sampling and analysis plans. The NCP specifically requires that "[sampling and analysis plans shall be reviewed and approved by EPA". 40 C.F.R. 300.430(b)(8). The fish study was conducted without an EPA-approved work plan, without EPA oversight, and with no review from the Trustees. During two meetings in the spring of 2002, the BMSG and EPA discussed performance of a fish study as a deliverable under the RI/FS process to represent post-Early Action and pre-Remedial Action conditions. The BMSG intentionally performed the study without informing and involving the EPA and Trustees. Second, EPA does not agree that the fish study demonstrates there are no negative effects on the fish populations in area creeks. It is important that all life stages of fish and macroinvertebrate populations be demonstrated to be consistently present under varying seasonal conditions for multiple years. The methodology in the fish study is unclear. The raw data have not been provided and the results are inadequate as presented to justify the assertions in this comment. Additional concerns regarding the BMSG's fish study are provided in the response to Exhibit C of the BMSG's comments.

Comment 3: *The BMSG has faced a moving target in the RI/FS process. For six years, the focus was on copper, pursuant to the 1995 Consent Decree. In 2001, EPA decided to establish a preliminary remediation goal (PRG) for cobalt in surface water at Blackbird Mine, despite the absence of a State or Federal standard. The BMSG and EPA have been debating the cobalt PRG for the past year. In late July 2002, after the FS was completed, without prior warning, EPA at the eleventh hour advised the BMSG that it would propose to use EPA water quality criteria in lieu of the Idaho standards for copper and arsenic, the latter never having been previously identified as a pollutant of concern for surface water.*

Response 3: As stated in the response to Comment 1 and more specifically discussed in the response to Comment 13, the 1995 Consent Decree established a natural resource restoration goal for copper. The 1995 Consent Decree expressly states that it did not establish a cleanup goal for the purposes of remedy selection.

The RI/FS is an iterative process. The RI/FS provides a process for EPA to identify and evaluate hazardous substances that may pose a threat to human health and the environment. The RI/FS AOC clearly placed the BMSG on notice that EPA intended to utilize the remedial procedures of CERCLA to address multiple pollutants and streams even if they were not covered by the 1995 Consent Decree (see response to BMSG comment 13). During the RI/FS, the presence of cobalt was identified as a potential threat to the environment. A risk evaluation of the threat posed by cobalt to fish was performed and a PRG was established. EPA provided the BMSG, the State and the Trustees an opportunity to comment on the PRG and there have been a number of discussions and meetings among EPA, the Trustees and the BMSG regarding the cobalt PRG. EPA has carefully reviewed the information and materials provided by the Trustees and the BMSG on the cobalt PRG and has concluded that the cobalt PRG is appropriate.

Throughout the RI/FS process, EPA retained the possibility that the EPA ambient water quality criteria (FWQC) could be applied to this Site as a relevant and appropriate standard. In September of 2001, the document covering Remedial Action Objectives/Preliminary Remediation Goals identified the FWQC as a potentially relevant and appropriate cleanup standard. In commenting on the draft FS in early 2002, EPA directed the BMSG to add a discussion of the FWQC as potentially relevant and appropriate and directed that a quantification of the FWQC be added to the relevant tables in the FS. The FWQC was added to the FS discussion as potentially relevant and appropriate. These ongoing references to the FWQC as potentially relevant and appropriate made it clear that the FWQC would be evaluated as a potential cleanup standard and that such evaluation could result in the use of the FWQC as the appropriate standard for this Site.

Comment 4: *The BMSG also has faced a moving target procedurally. When the proposed plan was announced on August 12, 2002, neither the administrative record for the plan nor the Blackbird site file were completed and available for review by the BMSG. Upon inspection early in September, there were still materials that we could not review because they had not been placed in the file or because there was uncertainty concerning the presence of privileged documents in the file. Moreover, more than 30 days is required to evaluate the complex and new issues raised by the proposed plan. Therefore, consistent with EPA guidance for complex sites, the BMSG requested a 60-day period for comments. EPA initially denied the request. Subsequently, by letter dated September 13, 2002, EPA reconsidered and granted the BMSG's request for an extension of time to October 10, 2002. We reserve and request the right to submit supplemental comments to address documents we have not previously received and issues we have not had sufficient opportunity to address fully in these comments.*

Response 4: When the proposed plan was announced, EPA had copies of the administrative record available for review in Seattle, Washington, Boise, Idaho and Salmon, Idaho. Additions were made to this administrative record to add correspondence with the BMSG and other materials familiar to the BMSG, as well as correspondence with the Trustees. These additional materials were made available to the BMSG for review and copies of many of the documents were provided to the BMSG. The BMSG had an opportunity to review these materials during the extra 30 days that were granted by EPA.

Comment 5: *EPA's proposal sets aside the applicable Idaho water quality standards for copper and arsenic and instead proposes to rely on the Federal Water Quality Criteria ("FWQC") as proposed remediation goals (PRGs). These proposed ARARs were announced just recently without warning or justification. They are not relevant or appropriate for several reasons. The FWQC is simply guidance, it is not an applicable standard. Pursuant to CERCLA and EPA's own policy, the applicable Idaho WQS are the proper ARARs, not the FWQC. The criteria for copper set forth in the Consent Decree and specifically the BRCP reflect the agreement of the parties and may not be changed by EPA. Moreover, the FWQC are not scientifically appropriate for the Blackbird Mine site. Finally, natural copper concentrations in nearby streams unaffected by Blackbird Mine exceed the FWQC for copper.*

Response 5: EPA has consistently stated that the cleanup selected in the ROD will be required to meet ARARs. In fact, the 1995 Consent Decree expressly states that "[n]othing in this Consent Decree is intended to predetermine or limit EPA's authority to select any Response Actions, including clean-up standards pursuant to Section 121 of CERCLA, 42 U.S.C. 9621, related to the Site". (Page 3 of 1995 Consent Decree) Section 121 of CERCLA specifically identifies the Federal Ambient Water Quality Criteria (FWQC) as potentially relevant and appropriate for cleanup actions and Section 121(d)(2)(B) of CERCLA establishes specific factors that EPA must evaluate to determine whether the FWQC is relevant and appropriate. The Proposed Plan requested comment on these specific factors. EPA has evaluated all of the comments received on this matter and has determined, based primarily on research provided by the State of Idaho, that the FWQC for copper are not relevant and appropriate under the circumstances of the release at this Site. The State of Idaho's research provides 1) a review of several studies of the effects of copper toxicity tests to relevant species which would occur at the Site and 2) a literature review of salmonid copper toxicity tests which indicates that the Idaho copper criteria would be protective of the coldwater aquatic life at the Site. Further discussion regarding this determination is contained in Chapters 8 and 13 of the ROD.

Comment 6: *There is no Idaho standard for cobalt applicable to surface waters at the Blackbird Mine, nor is there even an EPA FWQC for cobalt. Undaunted, EPA has invented a cobalt PRG for the Blackbird Mine site, which it then relies on to justify expensive remedial action for collection and treatment of groundwater from the West Fork Impoundment. The proposed cobalt cleanup level is not appropriate. It is inconsistent with the Consent Decree. It has not undergone peer review. It is based on an inaccurate evaluation of the available information and incorrect and unconventional manipulations of the available data. A proper assessment for cobalt demonstrates that no further reduction in cobalt is needed for protection of all life stages of salmonids in Panther Creek and Big Deer Creek.*

Response 6: In the absence of a state standard or federal criteria, development of a risk-based PRG for cobalt in surface water to evaluate protectiveness of alternatives in the FS and the selected remedy is consistent with the NCP. The proposed cobalt PRG (i.e., cleanup level) has been discussed in many meetings and conference calls with the BMSG and the Trustees. It is based on the best available scientific data. (See the response to the BMSG's Comment 30 below.) It has undergone review by the State, the Trustees and their contractors. EPA has carefully reviewed and analyzed all the comments and has, as appropriate, made changes to the technical analysis for the cobalt remedial goal. EPA has performed an appropriate evaluation of cobalt based upon the existing information. Based upon the results of this evaluation, EPA has determined that additional actions are necessary to address cobalt concentrations in surface waters at the site that continue to exceed the cobalt cleanup level. Finally, nothing in the 1995 Consent Decree precludes EPA from selecting a cobalt cleanup level for this Site.

Comment 7: *EPA's analysis of the effectiveness of the alternatives is fatally flawed, resulting in a proposed remedial plan that is inappropriate and arbitrary. EPA has undertaken no analysis of the achievability of its recently conceived, proposed PRGs for copper or arsenic, and indeed the draft FS was prepared before EPA decided to propose those PRGs. There is thus no basis to conclude that the proposed plan will achieve those inappropriate goals.*

Response 7: EPA disagrees that the analysis of the effectiveness of the alternatives is "fatally flawed". EPA has carefully reviewed the federal and state criteria for copper and arsenic in order to determine the appropriate cleanup levels for this Site. EPA has determined that the State of Idaho water quality criteria is the appropriate cleanup standard for copper. EPA performed a detailed review of the federal criteria for protection of human health related to arsenic in surface water as discussed in Response to Comment 28. EPA has determined that the Federal AWQC for arsenic is relevant and appropriate for evaluating surface water quality for protection of human health at a 10^{-4} risk level based on "consumption of organisms only" in those creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big

Deer Creek and Big Deer Creek). These creeks currently do not exceed the AWQC criteria of 14 ug/L.

Comment 8: *With respect to cobalt, EPA rewrote the evaluation of alternatives in the FS (Chapter 7), making major changes from the version submitted by Golder Associates for the BMSG. EPA's alteration biases the evaluation to support the selection of alternatives BB-7 and BT-5 in the proposed plan. A correct use of the loading reduction information is shown in Table 7-10 of the attached Section 7 of the FS and discussed below. See Exhibit A, Chapter 7, Focused Feasibility Study for the Blackbird Mine Site, Golder Associates, September 12, 2002. As discussed above, existing cobalt levels are protective and no further remediation is warranted.*

Response 8: EPA re-wrote portions of Chapter 7 of the FS because the BMSG was unwilling to appropriately incorporate EPA's comments on several draft versions of Chapter 7 of the FS (see additional discussion in the response to the BMSG's Comment 34 below). EPA does not agree that the loading reduction information provided in Exhibit A of the BMSG comments is an appropriate representation of the potential load reductions that would be experienced under the various alternatives. (See the responses to the BMSG's Comments 35 through 38 below for additional discussion of the load reduction tables.)

Comment 9: *EPA's proposed alternative BT-5 includes a pipeline for diversion of Bucktail Creek surface water around South Fork Big Deer Creek to achieve quality goals in South Fork Big Deer Creek. However, there is no basis to conclude that this would be the case. Moreover, no environmental benefit would be gained by attempting to achieve water quality goals in South Fork Big Deer Creek. It is poor potential fish habitat, and natural physical barriers (log jams and water falls) inhibit the colonization of fish. The alternative is also inconsistent with the Consent Decree.*

Response 9: The analysis in the FS showed that water quality PRGs, including the State water quality standard, are expected to be met in the South Fork of Big Deer Creek from reducing the metal loads into the South Fork of Big Deer Creek with the Bucktail Creek diversion. The ROD identifies that contingent action alternatives will be evaluated after the implementation of the Bucktail Creek diversion if metals discharges result in exceedances of water quality cleanup levels. One of the threshold criteria in the NCP for selecting an alternative is that ARARs must be met. There is a State water quality standard for copper in the South Fork of Big Deer Creek for cold water biota. Therefore, the EPA's selected remedy must meet the ARAR unless the ARAR is waived. The criteria to waive an ARAR is not currently met or justified. This response action is not inconsistent with the 1995 Consent Decree.

Comment 10: *With respect to the Panther Creek properties, EPA continues to overstate potential risks to human health. A scientifically valid analysis would show that the future residential use scenario for Panther Creek properties will not result in unacceptable potential future risks. There is thus no need to consider future removal actions or institutional controls on Panther Creek properties.*

Response 10: The human health risk assessment (HHRA) was performed following EPA guidance. In accordance with EPA guidance, risk estimates are based on reasonable maximum exposure assumptions. Using these reasonable maximum exposure assumptions, potential future risks for three private properties (assuming full-time residential use of the properties) exceed EPA's acceptable risk range. Therefore, future removal actions or institutional controls are needed for these properties. See the responses to the BMSG's Comments 46 through 50 for details of specific exposure assumptions and toxicity values used in the risk calculations for the HHRA.

Comment 11: *The alternatives proposed by EPA for stream sediments rely primarily on natural recovery of in-stream sediments. The BMSG agrees that this is the correct approach for in-stream sediments. However, the proposed plan should make it clear that there is no known risk to aquatic organisms at concentrations currently existing in the in-stream sediments.*

Response 11: Benthic invertebrate data continue to show impacts relative to reference locations; these data were collected by the BMSG and demonstrated that while populations have improved, benthic communities in areas impacted by mining disturbance are suppressed with respect to reference areas. In addition, there is not sufficient data available to justify that there are no known risks due to exposure to sediment. Therefore, EPA disagrees with the BMSG's assertion that there is no known risk to aquatic organisms due to current metal and arsenic concentrations in the sediment.

Comment 12: *In Section 6 of the FS, EPA has included possible "contingent actions" that might be evaluated by EPA if the selected actions do not meet remediation goals in an acceptable time frame. This type of 'catch all' listing of contingent actions is not appropriate. Given all the progress that has been made at the Blackbird Mine since 1995, the Superfund process should be drawing to a close, not launching into an open-ended series of actions.*

Response 12: The FS discusses that there is uncertainty concerning whether some of the components of the remedial action will be effective in meeting remedial action objectives (RAOs) and cleanup levels. Because of this uncertainty, the potential for contingent actions in the future must be acknowledged. The only other option is to take other actions now that have more certainty of achieving RAOs and cleanup levels but are more costly. The BMSG has objected to taking actions that have more certainty (for example, active treatment at the confluence of Bucktail Creek and South Fork of Big Deer Creek).

Comment 13: *In 1995, the BMSG agreed to undertake certain obligations specified in the Consent Decree, and in return the United States and the State agreed to release the BMSG with respect to all matters raised in the lawsuits. The 1995 Consent Decree provided that water quality goals would focus on attaining copper standards in Panther Creek and Big Deer Creek in order to sustain salmonids through all life stages. In contrast, EPA's proposed plan contains water quality goals for cobalt and arsenic, pollutants not specified, and addresses streams such as Blackbird Creek and South Fork Big Deer Creek that are not specified in the Consent Decree. EPA may elect to address pollutants or streams not covered by the Consent Decree using monies provided by the U.S. Superfund fund and the State. Alternatively, the Consent Decree may be* *modified by agreement of all of the parties. However, EPA may not unilaterally impose new obligations upon the BMSG.*

Response 13: The BMSG comments misinterpret the 1995 Consent Decree. The 1995 Consent Decree expressly states that it does not predetermine or limit EPA's authority to select any Response Actions, including establishing cleanup standards pursuant to CERCLA. (Section 1, page 3). This language recognizes that the 1995 Consent Decree does not limit EPA's responsibility to select a response action for this Site and that such response action is expected to comport with the requirements of CERCLA. The 1995 Consent Decree also states that EPA may establish a standard for water quality at the Site different from the standard set forth in the Consent Decree and establishes a process for the Trustees to modify the 1995 Consent to reflect the standard selected by EPA. (Paragraph 5(c) of the 1995 Consent Decree). These provisions of the 1995 Consent Decree clearly recognize EPA's authority to select a response action in accordance with the requirements of CERCLA.

Prior to the entry of the 1995 Consent Decree, the BMSG entered into an Administrative Order on Consent to perform the RI/FS for the Site. The RI/FS AOC made it clear that the RI/FS could include multiple contaminants; multiple stream segments and tributaries; and additional cleanup goals. This RI/FS AOC clearly placed the BMSG on notice that EPA intended to utilize the remedial procedures of CERCLA to address multiple pollutants and streams even if they were not covered by the 1995 Consent Decree. In addition, the BMSG was a signatory to the RI/FS AOC and agreed to the above.

Pursuant to the 1995 Consent Decree, the BMSG agreed to perform Response Actions related to the Site in accordance with the ROD which is being issued by EPA after completion of the RI/FS (Section I, page 3; Section V.B.b., Page 7). The 1995 Consent Decree clearly recognizes that these response actions are in addition to the NRD restoration activities.

Comment 14: *Attached to these comments are Exhibits that are referenced herein and are incorporated as part of these comments. We also reference various documents that we understand are in the administrative record. A list of references is included at the end of these comments. If any of these references are not contained in EPA's administrative record, please advise us promptly so that we may submit a copy for the record. If EPA adds documents or other information to the administrative record, or if EPA provides new explanations of the basis of or justification of its proposed plan, the BMSG requests notice and an opportunity to submit supplemental comments.*

Response 14: Comment Noted. All documents are already included in the administrative record with the exception of the Windward (2002) report. The BMSG was contacted to send the document to EPA for inclusion in the administrative record. EPA has not received the document from the BMSG.

Comment 15. *Early Action was initiated in 1995 and performed under an Administrative Order on Consent between the EPA and BMSG. The EPA, BMSG and the Natural Resource Trustees (Trustees) each agreed on the general approach necessary to control the release of copper from* *the site. The Early Action was performed with the intent to achieve the Consent Decree goal of protecting all life stages of salmonids in Panther Creek and Big Deer Creek downstream of the site. Major reductions in the concentrations of copper and other metals were achieved in Panther Creek and Big Deer Creek as a result of the Early Action. The success of the Early Action is evident in the reductions in copper concentrations in Panther Creek and Big Deer Creeks. In 1995, the peak copper concentrations measured in Panther Creek and Big Deer Creeks downstream of site tributaries were 0.218 mg/L and 0.342 mg/L, respectively. Peak copper concentrations during 2000 were 0.012 mg/L in Panther Creek and 0.021 mg/L in Big Deer Creek. This represents reductions of 94% in each stream.*

Response 15: In accordance with the 1994 RI/FS and Other Removal Action Administrative Order on Consent Statement of Work (AOC SOW) and paragraph 24 of the 1995 Removal Action AOC, the objectives of the Early Action were to support restoration of water quality and aquatic biota in Panther Creek below the confluence of Blackbird Creek to levels capable of supporting all life stages of anadromous and resident salmonids, and support restoration of water quality and aquatic biota in Big Deer Creek below the confluence of South Fork of Big Deer Creek to levels capable of supporting all life stages of resident salmonids. The significant reductions in dissolved copper loadings following the Early Actions were noted in the Feasibility Study and in Section 5 of the ROD. However, the dissolved copper concentrations in Panther Creek and Big Deer Creek still show a risk and do not meet EPA's remedial goals, the State WQS for copper and NPDES ARARs during significant portions of the year. Therefore, the additional actions identified in the ROD are necessary to meet the remedial goals and ARARs for copper and other contaminants of concern.

Comment 16: *The abundance of both fish and benthic macroinvertebrates, which represent a food source for salmonids, has increased substantially since the completion of the Early Action. The recovery of benthic macroinveretbrates was documented by Golder Associates in the RI Report. The agencies have also acknowledged the improvements in macroinvertebrate populations. In comparing 1995 and 1998 Panther Creek data collected by the Idaho Department of Environmental Quality, the State summarized "The results show significant improvements in the biological condition between 1995 and 1998.... In 1998, all metrics were more closer to upstream values, suggesting subtle impairment to the macroinvertebrate assemblage, versus the earlier severe effects." (IDEQ, 2001). Additional improvements have been documented since 1998. (See Exhibit B, Final Blackbird Mine Site Remedial Investigation Addendum, 2001 Sample Results, Section 6, Benthic Invertebrates, Golder Associates, September 12, 2002). Although slight differences in some species of organisms between upstream and downstream stations in Panther Creek remain, these differences are not believed to affect the ability of salmonids to obtain adequate food.*

Response 16: Given the limited benthic macroinvertebrate data available, populations of benthic invertebrates appear to have improved. However, benthic macroinvertebrate populations remain suppressed with respect to reference area populations. There remain clear differences in the various benthic invertebrate parameters between impacted and unimpacted areas. There is no evidence to support the BMSG's conclusion that food supplies are adequate for all life stages of salmonids. The BMSG's fish study (included in Exhibit C of the BMSG's comments) fails to provide this evidence.

Comment 17: *A fish study was recently conducted by consultants at the request of the BMSG (See Exhibit C, Assessment of the Presence, Abundance, and Condition of Fish in the Panther Creek Drainage, Beak International Inc. & Golder Associates, October 2002). This study shows that several fish species occur in abundance in Panther Creek, with no negative effects in terms of reduced population, biomass or condition downstream of Blackbird Creek or Big Deer Creek. Chinook salmon fry are present throughout a 30-mile length of Panther Creek, with significant numbers present between Deep Creek and Musgrove Creek, where the best spawning and rearing habitat occurs. Likewise, rainbow trout are present throughout Panther Creek at high densities, with a size-frequency distribution indicating that all life stages are supported throughout.*

The recent Beak/Golder study found that sampled fish were healthy with no difference in condition between upstream (reference) and downstream (affected) stations in Panther Creek. These results show that food and habitat conditions within mainstream Panther Creek are presently adequate to support healthy populations of salmonids in both affected and unaffected stream reaches. These findings are consistent with snorkel surveys conducted by the Idaho Department of Fish and Game (IDFG) in recent years. The IDFG snorkel surveys have documented major increases in rainbow trout in Panther Creek since completion of the Early Action. (See Exhibit C, Beak/Golder 2002.)

The remedial actions performed to date appear to be sufficient to protect all life stages of salmonids in Panther Creek. In Big Deer Creek, the Beak/Golder fish survey indicates evidence of fish recolonization. Continued improvements in fish and macroinvertebrate populations are expected to occur without further action at the site. It may take several years for the full benefits of the Early Action to be seen.

Response 17: There are numerous limitations regarding the BMSG's fish study (Exhibit C) as it is presented such that it cannot be used to justify the statements in this comment. For example, the BMSG's fish study was conducted without an approved work plan from the EPA. The BMSG failed to notify and acted without concurrence of the other stakeholders involved in the project. This action is inconsistent with the terms of the Administrative Order on Consent and the National Contingency Plan, 40 C.F.R. 300.430(b)(8), which require review and approval of the sampling plan by EPA. The BMSG fish study was conducted without review of the methodology or the results. The data cannot, therefore, be considered impartial. The methodology as presented is inadequate to determine if appropriate quality assurance procedures were followed. The methodology as presented is also inadequate to determine why some locations were sampled quantitatively while others were sampled qualitatively.

There are other limitations to this study as well. The results are inadequate to determine if the data are conclusive, or even suggestive. For example, while the BMSG states that dietary preferences were investigated by analyzing some fish unintentionally killed as the result of electroshocking, it is unknown how many fish of each species were analyzed. There are no statistics presented; therefore, it is unknown how reliable these results might be. It is also unknown if enough fish were collected to make a definitive statement regarding feeding habits. Thus, the BMSG's data are indicative of improved conditions, but are inconclusive.

In addition, prior to the survey, there was a failure in the outlet structure of the clean water reservoir on upper Blackbird Creek. This failure released potentially large numbers of fish downstream. This release confounds the current study, as it could skew the population data significantly.

The word "evidence" as used by the BMSG is misleading since data from only one sampling event are provided. These data represent only one sampling point in time. Because of this, the data are not sufficient evidence to determine the current or future state of fish populations in the impacted area creeks.

Water quality data apparently were not collected in conjunction with the fish data. Metal concentrations are low in August in Blackbird and Panther Creeks, the time during which the fish survey was conducted. Typically the copper WQS and cobalt remedial cleanup level are not exceeded in Panther Creek in August. This could have affected the status of fish populations in Blackbird and Panther Creek. The fish study data are inadequate to determine if fish occupy these habitats year round, or if peak concentrations of cobalt or copper produce elevated levels of mortality or morbidity, temporarily reducing populations or altering fish communities. This study does not demonstrate that further remedial actions are not needed to protect human heath and the environment. See also the comments to Exhibit C.

Comment 18: *The Site Characteristics section of the proposed plan does not distinguish between pre- and post-Early Action conditions and makes several inaccurate statements or assumptions that provide a flawed basis for the proposed remedial action. The proposed plan states that fisheries and aquatic resources downstream of the Blackbird Mine have been impacted by arsenic, copper and cobalt releases. EPA has not shown that arsenic and cobalt releases have ever impacted fisheries and aquatic resources at the site. Although the fisheries and aquatic resources were impacted by copper releases, substantial improvement in conditions has occurred as a result of the Early Action. EPA indicates that the copper concentrations in Panther Creek continue to frequently exceed the FWQC. This is not correct. The 2000-2001 data indicate that the State water quality standard for copper is met during low flow conditions which occur during most of the year.*

Response 18: The aquatic risk assessment shows a potential risk to aquatic receptors from arsenic, copper and cobalt. Both the federal water quality criteria and State water quality standard for copper are exceeded and the fisheries and aquatic resources are still impacted by copper releases despite the improvements in water quality from the Early Actions. EPA considers annual exceedances of the copper AWQC during high flow for several weeks as frequent. Therefore, the Site Characterization section in the Proposed Plan is accurate.

Comment 19: *In the proposed plan, EPA also fails to acknowledge that the area is highly mineralized with natural deposits. Releases from undisturbed mineralized areas naturally result* *in elevated metals concentrations in streams. For example, the RI report (Golder, 2001) documented that copper concentrations in tributary streams to Panther Creek (Clear Creek, Elkhorn Creek, South Fork Big Deer, Slippery Creek, Ludwig Gulch, Big Jureano Creek), free from any influence from the Blackbird Mine, have been measured at between 0.006 and 0.013 mg/L, which would exceed the FWQC for copper. Much higher concentrations can often be found in seeps and small tributary flows closer to natural sources.*

The FWQC for copper was likely exceeded in surface water downstream of the Blackbird Mine site prior to the existence of the mine. The systems installed under the Early Action are collecting and treating some of these natural sources of copper in addition to sources that resulted from mining operations. Remaining natural sources of copper could preclude attainment the FWQC for copper at some locations downstream of the mine. The BMSG reserves the right to submit supplemental comments and information that we may obtain in the future on natural sources of copper and other metals. It is important that EPA take into account sources other than Blackbird Mine and the substantial biological recovery that has already occurred instead of presuming the need for further remediation at the site.

Response 19: EPA has repeatedly encouraged the BMSG to develop a statistically valid study of background concentrations of the various media in the vicinity of the site. The BMSG's reluctance to pursue this study has meant that EPA has had to utilize existing information when background was being considered in setting PRGs at the site (e.g., the PRGs for overbank soils and in-stream sediments).

The existing data for area streams, where it appears that background may exceed the water quality goals, are often contradictory. This is potentially because the data were collected at different times by different entities utilizing different QA/QC procedures. For instance, the data for Clear Creek, Elkhorn Creek, South Fork Big Deer Creek, and Ludwig Gulch indicate that the water quality measured in the past has exceeded the water quality cleanup levels at some times and not at others. A more robust data set would be required to conclude that these creeks consistently exceed the water quality goals. Regardless, there are no data to indicate whether surface water downstream from the Blackbird Mine exceeded water quality goals prior to the existence of the mine.

Comment 20: *The Aquatic Ecological Risk Assessment, which is flawed in many respects, was used by EPA as a basis for development of inappropriate preliminary remediation goals (PRGs). The inappropriate PRGs resulted in the invalid evaluation of alternatives in the FS.*

EPA's flawed process of assessing risks to aquatic organisms was initiated in the Draft Aquatic Ecological Risk Assessment Work Plan received by the BMSG on October 27, 2000. The BMSG provided comments on the work plan to EPA on November 13, 2000 and on a subsequent version of the work plan on January 9, 2001. (See Exhibit D, BMSG Comments on EPA's Aquatic Ecological Work Plan, Risk Assessment, and Preparation of the FS Report.) Our comments focused mainly on the ecological management goals and assessment endpoints identified in the draft work plan. We pointed out our disagreement with setting goals in tributary streams to Big Deer Creek and Panther Creek. The Consent Decree set water quality goals only for Big Deer

Creek and Panther Creek. Setting ecological management goals and assessment endpoints in Blackbird Creek, Bucktail Creek and South Fork Big Deer Creek is unnecessary, unrealistic, and inconsistent with the Consent Decree.

EPA did not address or respond to our comments on the work plan and instead proceeded with preparation of the risk assessment, incorporating the inappropriate goals in the evaluation process.

Response 20: EPA considered the BMSG comments on the Aquatic Ecological Work Plan and Risk Assessment and did respond to the BMSG comments in writing, which is not a requirement. EPA did not agree with many of the BMSG comments on the work plan. The EPA is not limited by the terms of the Consent Decree (see Response No. 13). As discussed in response 13, the provisions of the 1995 Consent Decree clearly recognize EPA's authority to select a response action in accordance with the requirements of CERCLA.

Comment 21: *The 1995 Consent Decree set compliance points only for Big Deer Creek and Panther Creek. Experts for the BMSG and the agencies agreed during negotiation of the Consent Decree that establishment of restoration goals for Blackbird Creek, Bucktail Creek, and South Fork Big Deer Creek was not realistic.*

Subsequent to the entry of the Consent Decree, the State of Idaho prepared use attainability analyses for both Blackbird Creek and Bucktail Creek concluding that those streams cannot be remedied to achieve water quality criteria in the foreseeable future. (See Exhibit E, Use Attainability Analyses for Blackbird Creek and Big Deer Creek and BMSG Comment Letter). As a result, State aquatic life use designations were removed for these streams, with EPA approval. The BMSG commented in a November 7, 2001, letter (see Exhibit E) that the same determination should be made for South Fork Big Deer Creek. As a result of the use attainability analyses and changes in use designations, there was no basis for EPA to establish ecological management goals for aquatic life in these tributary streams.

Response 21: As discussed in response 13, the provisions of the 1995 Consent Decree clearly recognize EPA's authority to select a response action in accordance with the requirements of CERCLA. At a minimum, CERCLA requires EPA to achieve water quality levels that will be protective of the designated use for each stream. At this Site, Panther Creek, Big Deer Creek and South Fork Big Deer Creek are designated by the State of Idaho for use by cold water biota. Blackbird Creek's designated use is for secondary contact recreation. The selected remedial action must be protective of cold water biota for each of these designated stream segments and for secondary contact recreation in Blackbird Creek. The selected remedy must also result in improvements to impaired stream segments of Blackbird Creek and Bucktail Creek.

Comment 22: *We also object to setting ecological management goals and assessment endpoints to support threatened or endangered salmonid species on an individual basis, rather than on a population basis. Achieving population-level goals is the accepted scientific method for assuring recovery of species. There is no established method for setting goals and aquatic cleanup levels for individual organisms. Setting such ecological management goals for* *individual fish is not necessary or realistic and is not needed for compliance with the Endangered Species Act or for achieving the Consent Decree goal of protecting of all life stages of salmonids.*

Response 22: Establishment of ecological management goals and assessment endpoints protective of threatened or endangered salmonids at the individual level is an appropriate goal. This goal is intended to prevent mortality or reproductive failure of individuals which would then lead to population level effects. This is supported by 50 CFR Part 222, Final Rule on the Definition of Harm (Federal Register November 8, 1999; Volume 64, No. 215). Harm is defined therein as actions that kill or injure individuals of threatened or endangered species, or modify or impair their habitats. Metal concentrations at toxic levels can be considered to produce harm, and individuals therefore need to be protected. Finally, OSWER has issued a directive that requires protection at the individual level for special status species (OSWER Directive 9285.7-28P, Section III, Pg. 3). Therefore, EPA has acted in accordance with applicable Federal regulations and requirements in setting cleanup goals to be protective of threatened or endangered species on an individual level.

Comment 23: *The risk assessment focused too narrowly on the calculation and evaluation of hazard quotients (HQs) for the various metals at the site. In many cases, insufficient toxicological information exists to adequately establish toxicity reference values on which to calculate HQs. We pointed out that calculation of HQs should be a component of the risk assessment, HQs of greater than one cannot be used solely as an indication of unacceptable risk. A basic flaw in EPA's risk assessment is that it relies almost exclusively on the evaluation of HQs that are often based on unrealistically low toxicity threshold values. This flaw was carried into the establishment of remedial action objectives, preliminary remediation goals, and now the cleanup levels in the proposed plan. Comments on the cleanup goals for specific media and metals are provided below.*

Response 23: It is incorrect to state that insufficient toxicological information exists by which to calculate HQs. There are water quality criteria for most of the metals of concern. EPA relied on hazard quotients due to the lack of other types of data such as adequate benthic invertebrate data or fish population data. Cleanup levels were based on either ARARs, a weight of evidence approach, or HQs (see responses below).

Comment 24: *EPA provided no written response to the BMSG's 54 pages of comments and very few of the comments were addressed in the next draft of the Aquatic Ecological Risk Assessment. We submitted additional comments on July 27, 2001 (See Exhibit D). EPA finalized the risk assessment on August 27, 2001, with major disagreements on the ecological management goals and toxicity reference values unresolved. EPA carried its flawed ecological management goals and assessments of risk into the preparation of the FS and the establishment of remedial action objectives (RAOs) and preliminary remediation goals (PRGs). The BMSG reiterated its disagreement with EPA's risk assessments, RAOs, and PRGs in letters dated October 2 and December 28, 2001 (See Exhibit D).*

Response 24: EPA is not required to provide written responses to BMSG comments on any deliverable. BMSG comments are addressed in the final Aquatic Ecological Risk Assessment and RAO and PRG memorandum to the extent that EPA agreed with the comments.

Comment 25: *EPA May Not Substitute FWQC In Lieu Of Idaho Standards. EPA proposes to establish surface water cleanup goals for copper and arsenic based on the Federal Water Quality Criteria ("FWQC") as opposed to the Idaho Water Quality Standards. We submit that use of the FWQC would be inconsistent with the 1995 Consent Decree, the statutory requirements of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), and the guidelines established by EPA.*

Section 5(c) of the Consent Decree states that ambient water quality criteria for copper shall be achieved as set forth in the Biological Restoration and Compensation Plan (BRCP), to attain the goal of achieving a level of water quality in Panther Creek and Big Deer Creek sufficient to sustain all life stages of salmonids. At the time the 1995 Consent Decree was established, the copper FWQC and the copper criteria in the BRCP and the Idaho standard for copper in surface waters were identical. The copper standard was based on a minimum hardness of 25 mg/l. See Consent Decree Appx. B at 23-24 and IDAPA 58.01.02.210.

Although EPA established more stringent FWQC for copper in 1999, the criteria in the BRCP and the Idaho standards remain the same. It was the intent of the BMSG in 1995 that the copper criteria consist of that specified in the Consent Decree rather than a moving target incorporating then unknown, future EPA FWQC. As counsel for the United States and the State of Idaho stated in their letter to the BMSG dated April 25, 2002, p. 3 "we believe that the criteria set forth in the BRCP are consistent with our understandings developed during the negotiated process." EPA's proposal to establish copper FWQC for Blackbird Mine more stringent than the BRCP criteria violates the government's agreement in the 1995 Consent Decree. The United States (including EPA) and the State are bound as a matter of contract, namely the 1995 Consent Decree, from unilaterally changing a significant provision.

It is also well settled that, because consent decrees are recognized as contracts, any ambiguous terms in the decree can be interpreted using evidence of events and circumstances surrounding the negotiations. In this case, a court would likely consider that there were many parties involved in the consent decree negotiation, including the State of Idaho and the BMSG, and would conclude that it is unlikely that these parties would have agreed to the terms of the decree if they interpreted these terms as allowing EPA to unilaterally change the applicable water quality standard for dissolved copper. For these reasons, EPA cannot unilaterally change the water quality standard for copper at the Blackbird site. Such an action would constitute a breach of the Consent Decree.

That is not to say that the numerical copper standard cannot be changed. Like other provisions of the Consent Decree, the copper standard may be modified through Section XXXII (Modification). The modification provision states that "no material modifications shall be made to the BRCP without written notification to and written approval of the State, the United States, and Settling Defendants ... ." This reflects general principles of contract law governing consent *decrees. EPA, therefore, may not modify the water quality standard for dissolved copper provided for in the Consent Decree absent written approval from the BMSG.*

Response 25: The BMSG comments completely misinterpret the 1995 Consent Decree. The 1995 Consent Decree expressly states that it does not predetermine or limit EPA's authority to select any Response Actions, including establishing cleanup standards pursuant to CERCLA. (Section 1, page 3.) This language recognizes that the 1995 Consent Decree does not limit EPA's responsibility to select a response action for this Site and that such response action is expected to comport with the requirements of CERCLA. The BMSG's interpretation of Paragraph 5(c) contradicts the express language in that Paragraph in two regards. First, Paragraph 5(c) establishes the Federal Aquatic Water Quality Criteria as the criteria for copper. Second, Paragraph 5(c) expressly contemplates the possibility that EPA may establish a standard for water quality that differs from the standard set forth in the Consent Decree and establishes a process for the Trustees to modify the 1995 Consent Decree to reflect the standard selected by EPA. These provisions of the 1995 Consent Decree clearly recognize EPA's authority to select a response action in accordance with the requirements of CERCLA.

Comment 26: *FWQC are not promulgated standards and thus cannot be applicable or relevant and appropriate requirements ("ARAR"). CERCLA requires that remedial actions comply with "any standard, requirement, criteria, or limitation under any Federal environmental law . . .or any promulgated standard, requirement, criteria, or limitation under a State environmental . . . law . . . [that] is legally applicable . . . or is relevant and appropriate under the circumstances." EPA's regulations interpret this statutory mandate as requiring that applicable and relevant or appropriate requirements be promulgated federal or state standards.*

EPA guidance documents state that promulgated standards are those that are legally enforceable and of general applicability (See Exhibit J). A standard or requirement is legally enforceable if it contains enforcement provisions, or is enforceable "by means of the general authority in other [relevant] laws." A standard or requirement is generally applicable if the requirement is "applicable to all circumstances covered by the requirement." There are various indications of promulgation including "statute number, date of enactment, and the effective date of the requirement." Advisory and guidance documents, non-binding policies, and standards not of general applicability cannot be ARARs.

FWQC are not promulgated requirements. They are non-enforceable guidance developed under Clean Water Act Section 304 and are used by the States to establish water quality standards under Section 303. They do not contain any enforcement provision of their own, and cannot be enforced by other laws unless they are adopted and promulgated as state standards. Without promulgation, they are unenforceable guidelines. Further, FWQC are not applicable to all circumstances covered by the criteria because they constitute nothing more than general guidelines to aid States in establishing their own water quality standards. FWQC also do not carry any of the indications of promulgation as they have no statute number, no date of enactment, and no effective date. As such, FWQC do not meet the requirement that, to be an ARAR, a requirement must be promulgated. It would, therefore, be inappropriate for EPA to use the FWQC as the copper or arsenic ARAR at the Blackbird Mine site.

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Response 26: EPA agrees that the Federal Aquatic Water Quality Criteria (AWQC) provide non-enforceable guidance to States to establish water quality standards. However, Section 121(d)(2) of CERCLA expressly identifies the AWQC as a relevant and appropriate requirement. This section of CERCLA expressly requires that EPA evaluate specific factors to determine if the AWQC are relevant and appropriate. EPA has conducted such an evaluation for iron, copper and arsenic. For copper and iron, EPA has determined that the AWQC are not relevant and appropriate. For arsenic, EPA has determined that the Federal AWQC is relevant and appropriate for evaluating surface water quality for protection of human health at a 10^{-4} risk level based on "consumption of organisms only" in those creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big Deer Creek and Big Deer Creek). Further discussion regarding this determination is contained in Response to Comment 28 and in Chapters 8 and 13 of the ROD.

Comment 27: *Use of the FWQC for copper as the ARAR at the Blackbird site would be inappropriate because Idaho has promulgated a WQS for copper for the water bodies in question and FWQC are meant to be used only if a State fails to adopt its own standard. Two EPA guidance documents address situations where a FWQC and a state WQS are in conflict. EPA instructs that in such situations, the State WQS, and not the FWQC, should be used as the ARAR. In short, if "the State has promulgated WQSs for the specific pollutants and water body at the site," the state WQS is the proper ARAR, not the FWQC.*

The Idaho WQS for copper and arsenic should be applied at the Blackbird Mine site. Idaho has promulgated use designations for Panther and Big Deer Creeks, and has set water quality standards, including standards for copper and arsenic, for each of those uses. These WQS are specific to the particular creeks and have been duly promulgated by the State of Idaho. As such, they regulate Idaho water quality and are the proper ARAR for the Blackbird Mine site. Use of the FWQC for copper and arsenic at the Blackbird site would be inconsistent with EPA's established guidelines.

Response 27: EPA has determined that the State of Idaho water quality criteria are the appropriate cleanup standards for copper at this Site. EPA has determined that the FWQC for arsenic for human consumption of organisms is relevant and appropriate for the protection of human health in Panther Creek, South Fork Big Deer Creek and Big Deer Creek. This determination is based on the fact that the designated beneficial use of these creeks includes aquatic life. The use designation for aquatic life increases the probability of human consumption of fish. Since the Federal AWQC for arsenic was specifically developed to protect human health related to consumption of aquatic organisms, it is relevant and appropriate for Panther Creek, South Fork Big Deer Creek and Big Deer Creek.. Further information regarding this determination is contained in Response to Comment 28 and Chapters 8 and 13 of the ROD.

Comment 28: *The Idaho standard for arsenic in surface water for recreational uses is 50 µg/L. Because the state has promulgated a water quality standard for arsenic, the state standard should be applicable rather than the federal criterion. EPA has recommended that the national*

FWQC for arsenic in surface water of 0.14 µg/L (based on a 10^{-6} risk level) be applied to arsenic concentrations in Panther Creek, Idaho. This federal criterion for arsenic is not appropriate and relevant for the Blackbird Mine site and is currently under reassessment by EPA (U.S. EPA 1999). The national criterion is based on protection of human health from consumption of fish and shellfish that might accumulate arsenic from water. Several of the assumptions used in this default criterion, however, are scientifically inaccurate for site-specific exposure to arsenic in fish in Panther Creek. These assumptions include the bioconcentration factor, the relatively small amount of inorganic arsenic in fish tissue, the fish ingestion rate, and the target risk level.

The bioconcentration factor for arsenic in fish tissue from arsenic in water (44) is based on an intake-weighted average of bioconcentration factors for finfish (1) and the eastern oyster (350). In 1997, the State of Idaho recalculated the human health criterion for arsenic in water to be 6.2 ug/L based on a bioconcentration factor that the state believed more accurately reflected the fish species found in state waters (i.e., trout) (62 Fed. Reg. 52925-52927). EPA accordingly withdrew the federal criterion (62 Fed. Reg. 52925–52927). The State has since revised this standard to 50 µg/L (IDAPA 58.01.02 210). Because ingestion of shellfish is unlikely from Panther Creek, Idaho's approach to selecting the bioconcentration factor for the species at the site is appropriate.

The bioconcentration factor is also based on total arsenic in fish, not on the relatively smaller fraction that is in the more toxic inorganic form. The amount of inorganic arsenic in fish tissue is likely less than 10 percent (See Exhibit F, Exposure to Inorganic Arsenic from Fish and Shellfish, Donahue and Abernathy, 1999). Addition of the small percentages of monomethyl and dimethyl arsenic forms (see Exhibit F) would still result in a relevant concentration of arsenic for risk assessment that is considerably less than 100 percent of the total arsenic concentration. A recent risk assessment conducted for the Duwamish River in Region 10 applied a 10 percent adjustment factor to measured total arsenic in fish tissue to account for the proportion of total arsenic present in toxic forms (Windward 2002). This factor was recommended in EPA comments provided on the work plan. Application of a 10 percent adjustment factor to the modified criteria identified by the State of Idaho in 1997 would result in an FWQC of 62 µg/L.

The federal FWQC value of 0.14 µg/L for arsenic is based on a carcinogenic risk of 10^{-6}, as explained in the footnote to the FWQC. "Alternative risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right)." The risk level selected by EPA for Panther Creek is inconsistent with other risk management decisions at the site, which have used a 10^{-4} risk level. Application of such a risk level to the FWQC would increase it by one hundred times.

By introducing the proposed arsenic FWQC as an ARAR after the FS Report was completed, EPA has provided no analysis of whether or not the FWQC could be achieved by any of the alternatives. The detection limit for arsenic (typically 1.0 ug/L) used during the RI is greater than the 0.14 ug/L FWQC for arsenic. Most of the arsenic analyses conducted during the RI were below the detection limit. However, several samples from Panther Creek collected *upstream of Blackbird Creek and above any influence from the mine had detectable arsenic ranging from 1 to 4 ug/L. These results demonstrate that the FWQC is exceeded in background surface water and that the FWQC would not be met by any of the remedial alternatives.*

In conclusion, using more appropriate factors (i.e., bioconcentration, fraction of inorganic arsenic, fish ingestion rates) to calculate a health-protective criterion associated with fish ingestion at Panther Creek would increase the site-specific value by more than 100 times over the FWQC value. Use of target risk levels consistent with other risk management decisions at the site would increase the value by 100 times again (i.e. greater than 1400 ug/L). Therefore, the more appropriate and relevant Idaho State standard of 50 :g/L is more than adequately protective of human health from fish ingestion in Panther and Big Deer Creeks. The federal FWQC is exceeded in background surface water at the site and for this reason alone could not be used as a cleanup level. The Idaho standard is protective and is not exceeded in Panther Creek and Big Deer Creek either upstream or downstream of the mine. Therefore, there is no need for EPA to establish a cleanup level for arsenic in surface water.

Response 28: EPA has determined that the AWQC for arsenic for human consumption of aquatic organisms is relevant and appropriate for the protection of human health in Panther Creek, South Fork Big Deer Creek and Big Deer Creek. In reaching this decision, EPA reviewed the 2002 National Recommended Water Quality Criteria which establish two separate values for the protection of human health: (1) when contaminated organisms and water are consumed, 2) when contaminated organisms are consumed.

First, EPA reviewed the AWQC for protection of human health based on "consumption of water and organisms" and found that this AWQC is not relevant and appropriate based on the site-specific human health risk assessment. The Blackbird Mine Site Human Health Risk Assessment found that recreational contact to and ingestion of surface waters in the creeks containing elevated levels of arsenic does not present an unacceptable risk to recreational visitors or workers at the mine.

Second, EPA reviewed the Federal AWQC for protection of human health based on "consumption of organisms only" and found that the AWQC of 14 ug/L for arsenic is potentially relevant and appropriate for the purposes of reducing risk of human exposure based on consumption of organisms in Panther Creek, South Fork Big Deer Creek and Big Deer Creek. However, the AWQC is not currently relevant and appropriate for Blackbird Creek and Bucktail Creek since these creek are not presently protected for aquatic life.

Since Panther Creek, Big Deer Creek and South Fork Big Deer Creek are protected for aquatic life, the AWQC of 14 ug/L for arsenic is relevant and appropriate. EPA has reviewed the post-Early Action surface water monitoring data for Panther Creek, Big Deer Creek and South Fork Big Deer Creek to determine whether these creeks meet this criteria. There have been occasional exceedances of the arsenic AWQC criterion of 14 ug/L for the unfiltered samples in Panther Creek and South Fork Big Deer Creek. There have been no exceedances of the arsenic AWQC criterion in Big Deer Creek. For Panther Creek and South Fork Big Deer Creek, EPA applied a 95% UCL to the unfiltered sample data and concluded that the 95% UCLs for both Panther Creek and South Fork Big Deer Creek do not exceed the AWQC criteria of 14 ug/L. Further information regarding this determination is contained in Chapters 8 and 13 of the ROD.

Comment 29: *In the proposed plan for the Blackbird Mine site, EPA has proposed the use of the most recent federal recommended ambient water quality criterion for copper (EPA, 1999) in lieu of the State of Idaho's water quality standard for copper, as the applicable surface water aquatic life cleanup level for Panther Creek, South Fork of Big Deer Creek, and Big Deer Creek. In addition to the legal objections noted above, the selection of the 1999 EPA recommended criteria is inappropriate because it is not necessary for protection of the aquatic community in the site streams.*

This error stems from two sources. First, at all ambient water hardness levels, the 1999 EPA recommended criteria for copper is lower than the State of Idaho's water quality standard. This occurs because the EPA's 1999 recommended criteria are more heavily weighted by daphnid data. Since this group of species does not occur in the streams in and around the Blackbird Mine site, additional protection for them is not appropriate.

Second, the 1999 EPA recommended criteria include an unrealistic hardness regression, which does not establish a lower limit on the hardness-criteria relationship. This generates a scientifically indefensible low copper criteria at water hardness less than 25 mg/l. How low water hardness affects copper toxicity and where the no-effect threshold occurs is a significant scientific issue. This issue was identified in the National Toxics Rule (NTR), which established a threshold of 25 mg/l for the hardness-criteria relationship. This threshold is included in the State of Idaho's water quality standards. Unless and until scientific data become available to justify another hardness level, maintenance of the 25 mg/l threshold is appropriate.

Additional detail in support of these conclusions is set forth below.

The two sets of values being considered as cleanup levels for copper for the protection of aquatic life in the streams at the Blackbird Mine site are the 1999 EPA recommended water quality criteria and the current State of Idaho water quality standard. Each of these potential cleanup levels is described below.

The Idaho standard is based on a set of values established by USEPA, as specified in the National Toxic Rule (NTR). The copper criteria are expressed as two values which apply to different averaging periods – the Criterion Maximum Concentration (CMC) which is specified as a one-hour average and the Criterion Continuous Concentration (CCC) which is specified as a 24-hour average. Both the CCC and the CMC vary with hardness (i.e., the lower the hardness, the lower the criteria) and are specified by equations.

$$
\begin{aligned}
CCC &= e^{\{mc[\ln(hardness)]+bc\}(CF)} \\
&= e^{\{0.8545[\ln(hardness)]-1.465\}(0.960)}
\end{aligned}
$$

Use of this equation yields the following criteria at various hardnesses:

at hardness = 100, CCC = 10.7
at hardness = 50, CCC = 6.07
at hardness = 25, CCC = 3.44

$$CMC = e^{\{ma[\ln(hardness)]+ba\}(CF)}$$
$$= e^{\{0.9422[\ln(hardness)]-1.464\}(0.960)}$$

Use of this equation yields the following criteria at various hardnesses:

at hardness 100, CMC = 15.8
at hardness = 50, CMC = 8.44
at hardness = 25, CMC = 4.51

Both the CCC and the CMC equations plateau at 25 mg/l and 400 mg/l hardness – i.e., for any hardness <25 mg/l, a value of 25 mg/l is inserted into the equation and for any hardness >400 mg/l, a value of 400 mg/l is inserted into the equation. This approach is taken because according to the NTR "criteria documents for metals do not include data supporting the extrapolation of the hardness effects on metal toxicity beyond a range of hardness of 25 mg/l to 400 mg/l (expressed as calcium carbonate)"(Fed Reg 12/22/92, p. 60871).

The 1999 EPA recommended criteria is a set of values established by EPA in 1995 and corrected in 1999. As with the Idaho standards, the 1999 EPA recommended copper criteria are expressed as two values which apply to different averaging periods (i.e., the CCC and the CMC) and both vary with hardness (i.e., the lower the hardness, the lower the criteria) and are specified by equations. The equations differ from those used in the Idaho standards by having a different value assigned to one of the input parameters (bc in the CCC and ba in the CMC).

$$CCC = e^{\{mc[\ln(hardness)]+bc\}(CF)}$$
$$= e^{\{0.8545[\ln(hardness)]-1.702\}(0.960)}$$

Use of this equation yields the following criteria at various hardnesses:

at hardness = 100, CCC = 8.53
at hardness = 50, CCC = 4.83
at hardness = 25, CCC = 2.74

$$CMC = e^{\{ma[\ln(hardness)]+ba\}(CF)}$$
$$= e^{\{0.9422[\ln(hardness)]-1.700\}(0.960)}$$

Use of this equation yields the following criteria at various hardnesses:

at hardness = 100, CMC = 12.6
at hardness = 50, CMC = 6.73
at hardness = 25, CMC = 3.59

In the 1999 EPA recommended copper criteria, there are apparently no limits on the application of the hardness extrapolation. Therefore, as the ambient water hardness falls below 25 mg/l, the criteria values continue to decrease.

There are two major differences between the Idaho water quality standard for copper and the 1999 EPA recommended water quality criteria. First, at all hardnesses, the 1999 EPA recommended criteria for copper are lower than those stated in the State of Idaho's water quality standards (and similarly in the NTR). For example, based on the data presented above, at an ambient water hardness of 25 mg/l, the CCC is 2.74 ug/l Cu under the 1999 EPA recommended criteria and 3.44 under the State of Idaho standards. A review of the underlying data indicates that the 1999 EPA recommended criteria are lower than the State of Idaho's standards due solely to the inclusion of more sensitive daphnid data into the database used to calculate the 1999 EPA recommended criteria. The inclusion of the lower daphnid toxicity test results drives the CMC and, consequently, the CCC to lower values. Since daphnids are not a component of the aquatic community found in the Blackbird Mine site streams, the use of the 1999 EPA recommended criteria is not necessary to protect the aquatic community.

The data demonstrating the paramount role played by daphnids in lowering the 1999 EPA recommended criteria are illustrated by comparing Table 3 of the 1996 Water Quality Criteria Updates (the basis for the 1999 EPA recommended criteria) with Table 3 of the 1985 EPA Ambient Water Quality Criteria document for copper (the basis for the NTR and, consequently, the Idaho water quality standards). In the 1995 document, two daphnid genera are rated first and second in sensitivity to copper, with genus mean acute values of 9.92 and 14.48 ug/l. In the 1984 document, the same two daphnid genera are rated second and third most sensitive, with genus mean acute values of 17.08 and 18.77 ug/l. Since the sensitivities of all other genera remain essentially unchanged, the calculations leading to the lower CMC and CCC values in the 1999 EPA recommended criteria are due solely to these revised daphnid sensitivities. The second major difference is that the 1999 EPA recommended criteria do not have a lower limit on the hardness regression, whereas the Idaho standard (and the NTR) does. At this time, the issue of the "plateauing of the hardness-toxicity relationship" has not been totally resolved. However, based on mechanistic considerations and limited empirical data, it is likely that the hardness-toxicity relationship levels off at low hardnesses. The exact threshold is unknown. In the face of this uncertainty, the approach taken in the Idaho standards and by EPA in the NTR seems the most prudent. The selection of costly cleanup alternatives based on the possibility of slightly greater toxicity at hardnesses less than 25 mg/l is not warranted.

Response 29: The State provided comments on the Proposed Plan that provided further information documenting the protectiveness of the Idaho water quality criteria. These comments included a review of relevant copper toxicity testing with salmonids and site-specific studies relating threshold effects of copper. Based on this information, the State determined that Idaho's existing copper criteria, including a hardness cap at 25 mg/L, would be sufficiently protective of the aquatic life at the Site. EPA reviewed the State's analysis and has concluded that the State's determination is reasonable given the information that is currently available with respect to copper toxicity and the aquatic life expected to be present at the Site. Since EPA has determined that the State of Idaho water quality criteria for copper is the appropriate cleanup standard for copper at this Site, the assertions of the BMSG in this comment are no longer relevant. Further information regarding this determination is contained in Chapters 8 and 13 of the ROD.

Comment 30: *There is neither a State of Idaho standard nor an EPA ambient water quality criterion for cobalt. There is thus no standard for cobalt applicable to surface waters at Blackbird Mine. Nor is cobalt addressed in the 1995 Consent Decree. Accordingly, EPA should not be basing remedial goals and remedies on the presence of cobalt in surface waters. Undaunted by the absence of any published standard, however, EPA Region 10 has made one up just for the Blackbird Mine site. In particular, EPA has proposed a cleanup level (or PRG) for cobalt of 0.038 mg/l for the protection of salmonids, based on their "weight of evidence" evaluation of available data. A review of this proposed cleanup level and the underlying methodology used in its development clearly indicates that the proposed cleanup level is not appropriate, having been developed by an inaccurate evaluation of the available information and incorrect and unconventional manipulations of the available data. (See Exhibit G, Review of USEPA's Cobalt Toxicity Reference Value Position Paper & Responses to Comments, S.R. Hansen, Ph.D., September 11, 2002).*

EPA has inappropriately treated its cobalt PRG as a "threshold" criterion that must be met in order for an alternative to be considered for selection. As discussed below, no further reduction in cobalt is needed for protection of all life stages of salmonids in Panther Creek and Big Deer Creek. EPA's changes to the FS resulted in biasing the analysis of alternatives to imply that the only alternatives that would be protective of the environment are those that include collection and treatment of groundwater discharges from the West Fork Impoundment.

Two site-specific studies performed for the Blackbird Mine site clearly indicate that a cleanup level of between 0.124 and 0.213 mg/l would be appropriate for the protection of salmonids in streams in the vicinity of the Blackbird Mine site. (RCG/Hagler Bailly 1995, Hydroqual Lab 1996). The results of these studies are the most relevant in determining concentrations of cobalt that are safe for salmonids in the streams in question. In fact, the studies were designed specifically to identify the maximum concentration of cobalt that would be safe to the most sensitive life-stages of salmonids in the ambient waters found in streams at the Blackbird Mine site. The studies were performed by two independent scientific groups (one hired by EPA and the other hired by BMSG). The test organisms were swim-up fry (the most sensitive life-stage of salmonids to metal exposure), which were exposed for up to 60 days to various concentrations of copper. The results from both tests were remarkably similar; indicating that there was no adverse impact to these sensitive test organisms at 0.213 mg/l in one test and 0.124 mg/l in the other test. Based on these results, it is clear that a cleanup level set at between 0.124 and 0.213 mg/l would be safe to salmonids in the streams at the Blackbird Mine site.

The conclusions drawn from the two site-specific studies are strongly supported by fish sampling in streams in the vicinity of the Blackbird Mine site. Recent fish sampling conducted at the site showed that juvenile chinook salmon and rainbow trout were utilizing lower Blackbird Creek (See Exhibit C, Beak/Golder 2002). Based on sampling conducted during the RI, the cobalt *concentration at the mouth of Blackbird Creek is consistently higher than 0.213 mg/l under low flow conditions.*

EPA has selected a cobalt cleanup level based on the Aquatic Risk Assessment dated August 27, 2001, and a Cobalt Toxicity Reference Value Position Paper dated August 14, 2001. We have attached detailed comments prepared by Dr. Stephen R. Hansen on the Cobalt Position Paper and responses to additional comments made by CH2M Hill on the subject during a March 21, 2002, meeting. (See Exhibit G). EPA identified cobalt toxicity reference values (TRVs) for the Blackbird Mine site, which are purported to be protective of threatened and endangered salmonid species (set at 0.038 mg/l) and their invertebrate food supply (set at 0.023 mg/l). Hansen's review of this document and the supporting scientific literature shows that both of these selected TRVs are inappropriate because they are based on (1) insufficient and misinterpreted data, and (2) unconventional and incorrect manipulations to reach apparently preconceived values.

Response 30: EPA agrees there is no ambient water quality criterion for cobalt nor other ARARs for cobalt in surface water. Under the NCP, when an ARAR is not available, remedial goals that are protective of human health and the environment must be set (40 CFR 300.430(f)(2)(i)). For the protection of the environment, assessments are to be performed and used to establish these levels (especially for sensitive and critical habitats of species protected under the Endangered Species Act). According to EPA's ecological risk assessment guidance, the best available science is used as part of the basis for the environmental assessment. The proposed cobalt cleanup level is based on the best available information and is neither inaccurate nor unconventional.

Since the toxicological and site specific data are limited and uncertain, EPA has applied uncertainty factors to its calculations to ensure that the cobalt PRG is protective of all life stages of salmonids. EPA has maintained that if the BMSG desires to modify the current cobalt remedial goal, it must be done on the basis of a well designed biomonitoring study in conjunction with and independently confirmed by a cobalt laboratory toxicity bioassay. The biomonitoring study design and data quality objectives need to be approved by EPA, and the toxicity bioassay conducted by an impartial third-party in order to be defensible. EPA's position regarding biomonitoring and toxicity testing was detailed in a letter to the BMSG dated April 22, 2002.

The two site-specific toxicity studies performed to date for the Blackbird Mine site do not clearly indicate that a cleanup level of between 0.124 and 0.213 mg/L would be appropriate. While the results of these two studies are relevant for determining acceptable concentrations of cobalt that are safe for salmonids in the streams in question, there are severe limitations with both of these studies that preclude the use of either without appropriate uncertainty factor(s). These limitations were discussed in meetings in March 2002 with the BMSG, as well as during conference calls preceding and following the March 2002 meeting.

The first endpoint of 0.124 mg/L is from a study conducted for only 14 days. The other endpoint of 0.213 mg/L is from a 60-day toxicity test that, according to data provided by the BMSG, utilized a resistant strain of trout. As discussed with the BMSG, the data indicate a wide range in sensitivities between different strains of rainbow trout. The BMSG inadvertently tested resistant as well as more sensitive strains. It is unknown whether the strains tested fully encompass the range of sensitivities that might be found if a test was designed to fully define intraspecific sensitivity. However, the intraspecific sensitivity strongly suggests that interspecific sensitivity would be at least as large. This supports use of an uncertainty factor to both of the endpoints proposed by the BMSG as cobalt cleanup levels.

The fish sampling referred to by the BMSG is the fish study that was conducted without an approved work plan, without regulatory oversight, and without any review of the methods used. The methodology presented in this fish study is inadequate. The results presented in the fish study are inconclusive. The raw data were not provided with the fish study; therefore, the results cannot be fully interpreted, nor conclusions independently verified.

The cobalt concentrations at the mouth of Blackbird Creek frequently exceed the proposed cobalt cleanup level, but concentrations in Panther Creek were below the cleanup level and had been for several months prior to the BMSG's fish study (see Table 5-9 in the ROD). The temporary presence of fish does not justify increasing cobalt cleanup levels, because it is unknown if these fish were permanent residents, or how long they had been in the vicinity. In addition, it is unknown if the habitat could sustain these fish on a long-term basis given the much higher cobalt concentrations that occur in Blackbird Creek and Panther Creek at times of the year other than when the BMSG conducted their fish study.

EPA has selected a cobalt cleanup level designed to be protective of salmonids and their food supply without being overly conservative. The invertebrate TRVs were used in the aquatic ecological risk assessment and suggested that some impacts could occur to invertebrate populations; in fact, invertebrate populations are suppressed in the areas impacted by mine-related wastes. However, EPA recognized that the PRG could be higher than the TRV and have adequate ecological function. EPA recognized that the invertebrate TRV could be overly conservative for the Panther Creek ecosystem, and that slightly higher concentrations could be considered protective. Therefore, the invertebrate TRVs identified in the aquatic risk assessment (dated August 27, 2001) were not used as cleanup level. In part this was because the invertebrate population data indicate that invertebrate populations have improved in Panther Creek. The BMSG's review of the aquatic risk assessment and cobalt toxicity reference value position paper (dated August 14, 2001) failed to demonstrate that the TRVs were inappropriate. Furthermore, they are not based on insufficient nor misinterpreted data or unconventional or incorrect manipulations. See also EPA responses to Exhibit G of the BMSG's comments.

Comment 31: *One would expect that the errors in interpretation and calculation for the cobalt PRG would have been detected and corrected by peer reviewers prior to issuance of the Cobalt Position Paper. Perhaps contributing to these errors is EPA's apparent failure to follow its own guidelines for peer review in the establishment of these TRVs.*

EPA has published a variety of policies, including its policies for the Mandatory Agency-wide Quality System, the EPA Quality Manual, Peer Review and Peer Involvement at EPA, and the Peer Review Handbook. These policies have been ignored in preparation of the proposed plan.

In these policy documents, EPA has stated that it will strive to use (1) the best available, peer-reviewed science and supporting studies, and (2) data collected by the best available methods. EPA is supposed to have in place a quality management plan, to assign a quality assurance manager to conduct independent oversight of the quality system, and to conduct an assessment of data used to support agency decisions. These requirements also apply to EPA contractors. For significant work products, external peer review is to be used. No such peer review was undertaken by EPA Region 10 in developing the cobalt PRG.

EPA has also identified these peer review policies as a mechanism by which it will meet its data quality requirements under the Data Quality Act. Under this Act, EPA must ensure and maximize the quality, objectivity, utility, and integrity of all information it disseminates. The cobalt PRG is information covered by the Act because it is the communication of facts regarding the cobalt level necessary for salmonid protection. EPA disseminated this information to the public when it published the PRG in the Blackbird Site proposed plan. EPA must, therefore, ensure and maximize the objectivity of the cobalt PRG. EPA has stated that it will use its peer review policies and process to ensure the required objectivity. EPA's failure to undertake peer review prior to disseminating the cobalt PRG compromises the information's objectivity.

Response 31: Formal peer reviews are conducted on a case-by-case basis for scientific and/or technical work products that have been determined by EPA at it's discretion to be "major" work products. Major work products are typically those that are used to support a regulatory decision or policy/guidance of major impact. The BMSG mis-interprets and mis-states the EPA Peer Review Handbook. For example, the Handbook states on page 26 and 27 that "Scientific and technical work products that are <u>used to support a regulatory program or policy position</u> and that meet one or more of the following criteria are <u>candidates</u> for peer review...". In this case the cobalt TRVs and the cobalt PRG were developed for the Blackbird Mine site only considering site-specific conditions and were not used to support a regulatory decision or policy position. In addition, the cobalt TRVs were developed based upon review of data and analyses presented in existing literature and site-specific studies (one of which was performed by the BMSG). Thus, it is not necessary to utilize formal peer review since the underlying data in the existing literature have already undergone peer review. The cobalt TRVs and PRG were reviewed by scientists and technical experts from the State of Idaho, NMFS, the Forest Service and Forest Service contractor, as well as the BMSG. The comments of the technical reviewers were considered in setting the cobalt cleanup level. EPA did use the best available science and supporting studies.

Comment 32: *In a September 7, 2001, technical memorandum on Remedial Action Objectives and Preliminary Remediation Goals for the Blackbird Mine Site (RAO/PRG memorandum), EPA correctly rejected the 0.023 mg/L TRV for benthic invertebrates because it was biased low due to the inclusion of daphnid data, recognizing that daphnids are not found at the Blackbird Mine site. However, EPA adopted the salmonid TRV of 0.038 mg/L as the PRG (and in the proposed* *plan as the cleanup level). In adopting the salmonid PRG the RAO/PRG memorandum states "It is also important that cobalt remain below a level of 50 ug/L, at which concentration it is known from site-specific toxicity testing to enhance copper toxicity to salmonids." Dr. Hansen's attached detailed comments (Exhibit G) demonstrate that the cobalt-copper interaction tests were incorrectly interpreted by EPA and, in fact, the test results showed no statistical difference in the toxicity of copper in the presence or absence of cobalt and that there is no evidence of additivity and/or synergism between cobalt and copper. It is apparent that available site data and literature data were selectively evaluated and manipulated in the Cobalt Position Paper in order to arrive at a cobalt TRV less than 0.050 mg/L.*

Dr. Hansen's review of the relevant literature demonstrates that EPA's proposed cobalt TRV of 0.038 mg/l for salmonids in Panther Creek is incorrect and that an appropriate salmonid TRV, based on site-specific data, should be set between 0.125 and 0.213 mg/l. Panther Creek and Big Deer Creek cobalt concentrations are consistently less than 0.125 mg/L at the present time. Therefore, there is no need for EPA to establish a cobalt cleanup level for the proposed plan. This finding is corroborated by the recent fish sampling in Blackbird Creek that showed juvenile salmon and trout are utilizing habitat with concentrations far in excess of EPA's proposed PRG. (See Exhibit C, Beak/Golder 2002.)

Response 32: As noted, it is true that the cobalt TRV for invertebrates was not used as the remedial cleanup level. Daphnia are ubiquitous in water quality criteria testing not only because they are sensitive, but because they are amenable to toxicity testing procedures and can be maintained in the laboratory. Several of the chronic water quality criteria make use of data from only three taxonomic groups, these groups being Daphnids, Amphipods, and Chironomids. Because of their sensitivity, daphnids and amphipods are used as "indicator" organisms. Their sensitivity relative to Panther Creek taxa is unknown due to the paucity of invertebrate data and because full life cycle tests with certain taxa such as mayflies are difficult to perform. However, because daphnia are not expected to inhabit the lotic ecosystem of Panther Creek, EPA acknowledged that water quality cleanup levels should consider, but not be heavily biased by, daphnia data. This qualitatively acknowledges their contribution to the available knowledge regarding toxicity. EPA has also acknowledged that by doing so, some invertebrate taxa may not be protected by the current remedial cleanup level for cobalt of 0.038 mg/L.

EPA has previously responded to Dr. Hansen's opinion that the cobalt/copper interaction test was incorrectly interpreted by EPA. EPA has acknowledged that the test results showed no statistical significance; however, a definite trend is apparent. EPA has reiterated the position of the authors who performed and published the study. Further discussion on this point can be found in the responses to Exhibit G of the BMSG comments.

Dr. Hansen's review of the relevant literature fails to demonstrate that EPA's cobalt remedial cleanup level of 0.038 mg/L for salmonids in Panther Creek is incorrect. The data do not demonstrate that the cobalt cleanup level should be set between 0.125 and 0.213 mg/L, but demonstrate clearly that the cleanup levels should be set below 0.125 mg/L. The upper bound stated as appropriate by Dr. Hansen is from the 1996 Hydroqual test. The 1996 Hydroqual test would not be considered an acceptable test under EPA criteria derivation guidelines. EPA guidelines call for the rejection of any test that uses unusually sensitive or resistant organisms. There is sufficient reason to believe that the 1996 Hydroqual test used resistant organisms, leading to the rejection of the 0.213 mg/L value. The fact that sensitivity to cobalt appears to span nearly an order of magnitude within a single species is evidence to support use of an uncertainty factor applied to the lower bound value of 0.125 mg/L in order to account for interspecific and intraspecific variability.

The recent fish sampling in Blackbird Creek indicated that at the time sampling occurred, juvenile salmon and trout were utilizing this habitat. However, it is unknown how long these fish would remain in Blackbird Creek. These fish could have been seeking thermal refuge, and because the BMSGs fish study lacked temperature data, this is unknown. The mouth of Blackbird Creek is small enough that fish could move in and out in conjunction with changes in metal concentrations or temperature. The current BMSG fish study does not provide sufficient data to demonstrate that fish can inhabit these areas for extended periods at dissolved metal concentrations above the cobalt remedial cleanup level. See the responses to Appendix C of the BMSG's comments for further discussion of the limitations of the BMSG fish study.

Comment 33: *EPA arbitrarily proposes to establish a non-numeric aquatic life goal for Blackbird Creek "to support aquatic life at levels similar to that of nearby reference streams, although not necessarily to support salmonids or metals-sensitive macroinvertebrate species." Contrary to the Consent Decree, the State of Idaho's use attainability analysis and the Early Action work, this goal is for the first time identified in the July 1, 2002, Addendum to the Remedial Action Objectives and Preliminary Remedial Goals Technical Memorandum without any explanation to justify the goal. We note that the July 1, 2002, memorandum includes the phrase "...aquatic life at levels somewhat similar to that of nearby reference streams..." The word "somewhat" was dropped in the proposed plan, also without explanation. Whether the phrase is "similar" or "somewhat similar," the provision is hopelessly vague.*

As discussed above, State aquatic life use designations were removed from Blackbird Creek based on IDEQ's use attainability analysis. The only State use designation for Blackbird Creek is secondary contact recreation. EPA acknowledges this point in the July 1, 2002, memorandum, stating: "There is not a State water quality standard for Blackbird Creek because the State of Idaho removed the beneficial use designation for aquatic life for Blackbird Creek through a use attainability analysis." EPA acknowledges that numeric cleanup goals are not needed for protection of secondary contact recreation uses because existing metal concentrations are below levels that would be set for that purpose. EPA then inexplicably goes on to state the vague, non-numeric goal for Blackbird Creek, based on aquatic life in a similar reference stream.

In addition to the fact that the non-numeric goal is contrary to existing regulations and the Consent Decree, it would not be possible to interpret the goal or to determine when it is achieved, without a serious potential for dispute by different parties and different scientists. There is no explanation how the phrase "similar (or somewhat similar) to that of nearby *reference streams" would be interpreted by EPA or a court. Nor is there an explanation as to how "although not necessarily to support salmonids or metal-sensitive macroinvertebrate taxa" should be interpreted. If not salmonids, then what fish species? What macroinvertebrate species are expected and what is the designated use that they would provide?*

The non-numeric goal for aquatic life in Blackbird Creek is ill-conceived and inconsistent with State and Federal regulations and should be deleted. We note that EPA correctly points out in the proposed plan that, because there are no designated beneficial uses for aquatic life in Bucktail Creek, cleanup levels for protection of aquatic life are not applicable. This is also the appropriate determination for Blackbird Creek.

Response 33: It is necessary to have at least a non-numeric goal for aquatic life in Blackbird Creek for at least two reasons. EPA originally had planned to set numeric goals in Blackbird Creek to ensure that Panther Creek was protected. The non-numeric goal was developed in response to BMSG's concerns about such numeric goals in Blackbird Creek based on the uncertainty of the effectiveness modeling. Such a non-numeric goal was designed to ensure that remedial actions are selected so that water quality in Blackbird Creek will be improved such that cleanup levels are not exceeded downstream in Panther Creek. In addition, it is important that any remedial action not adversely affect the existing habitat in Blackbird Creek that has ecological benefits. There is considerable habitat in Blackbird Creek that can support some aquatic life (see BMSG fish study in Exhibit C), and it is likely to be able to support more aquatic life when the water quality is improved through implementation of the remedial actions. Therefore, the non-numeric goal is consistent with the NCP and the requirement to select remedies that are protective of the environment and that maintain protectiveness over time.

EPA agreed that cleanup levels were not applicable for Bucktail Creek, not because there were no beneficial uses for aquatic life, but because the small size and steep gradient of Bucktail Creek provide virtually no habitat for fish, and very limited habitat for benthic invertebrates.

Comment 34: *In finalizing the Feasibility Study (FS), the EPA without explanation rewrote the evaluation (Chapter 7), making major changes from the version submitted by Golder Associates for the BMSG. The EPA altered the evaluation substantially so as to bias it to support selection of alternatives BB-7 and BT-5. As part of these comments, the BMSG is resubmitting Chapter 7 (see Exhibit A) so that the Administrative Record contains an appropriate evaluation that should have been used in selecting remedial alternatives for the proposed plan.*

Response 34: EPA submitted detailed comments on the initial draft of the FS and on the draft final version of the FS. In addition, EPA's comments were discussed at length during meetings and teleconferences following the submittal of comments on the draft and draft final versions of the FS. Because of concern over the proper inclusion of EPA's comments on Chapter 7, EPA requested that the BMSG prepare and submit for review a revised Chapter 7 incorporating EPA's comments on the draft final FS prior to submitting the remainder of the final FS. Based on our review of this revised Chapter 7 (which was the third version of Chapter 7 prepared by the BMSG), it became apparent that the BMSG was resistant to incorporating EPA's comments appropriately. Rather than continue with the comment and response procedures, EPA determined that it would be more efficient to re-write portions of Chapter 7 to appropriately incorporate previous EPA comments.

Comment 35: *With respect to the evaluation in Chapter 7, the EPA changed the assumed removal percentages used in the post-remediation concentration estimates. In particular, the EPA assumed significantly lower cobalt reduction due to a soil/clay cover over the West Fork Tailings Impoundment. This change resulted in the EPA's concentration estimates for cobalt being higher than Golder's calculations. The EPA used their higher cobalt concentration estimates to support selection of alternative BB-7 over alternative BB-6. However, Golder's calculations show that alternative BB-6 would also meet EPA's cobalt PRG in Panther Creek. However, as discussed earlier in these comments, the BMSG disagrees with EPA's cobalt PRG and believes that current water quality is protective.*

EPA made changes to Golder's post-remediation concentration calculations without documenting any basis for the changes. The differences are shown in the attached table (Table 1, Differences in Removal Percentages). With respect to post-remediation cobalt concentrations, Appendix D (Table D-5) of the FS, as approved by EPA, gives the following "cumulative predicted reduction": low – 34%, intermediate – 48%, high – 69%. In the Golder version of the concentration prediction tables in Chapter 7, these values were used (rounded) for the "minimum," "best estimate," and "maximum" estimated removal percentages due to the overall cover. Golder and EPA held many discussions on the modeling presented in Appendix D. EPA and BMSG experts held a detailed discussion of the modeling, and the results of this discussion have been documented in the BMSG response to comments (on a draft FS) dated April 22, 2002. By approving the final FS with this appendix, the EPA has documented their acceptance of the validity of Appendix D. The uncertainty in the data and the modeling is noted by Golder and the BMSG, but Appendix D presents the best available information on the potential effects of a soil cover on the West Fork Tailings Impoundment. Therefore, it was inappropriate for EPA to ignore or modify the information in Appendix D in its calculations of predicted cobalt calculations.

Rather than straightforward use of the Appendix D predicted reductions, and without any documented basis, the EPA used the low predicted reduction as the "best estimate," used the intermediate reduction as the "maximum," and ignored the high predicted reduction. EPA made similar changes to the "soil cover (no clay)" removal percentages (which correspond to the "3-m soil" predictions in Table D-5). Thus, EPA has selectively ignored information in the approved Appendix D, created new predictions without providing any basis, and uses the predicted reductions in an arbitrary manner inconsistent with EPA's presentation in the Appendix.

EPA's arbitrary changes to the FS resulted in biasing the analysis of alternatives to imply that the only alternatives that would be protective of the environment are those that include collection and treatment of groundwater discharging from the West Fork Impoundment and biasing the evaluation against those that rely on the soil cover to reduce cobalt loading.

Response 35: EPA agreed with many of the estimated removal efficiencies that were proposed by the BMSG in developing the water quality predictions for the various alternatives (see Table 7-9 from the FS). However, as noted in the response to the BMSG's comment 36 below, there is a very large degree of uncertainty in the output parameters of the hydrogeochemical model developed for the West Fork Impoundment cover. Because of this degree of uncertainty, EPA determined that the cobalt removal efficiencies assumed by the BMSG were overly optimistic. Thus, EPA developed its own estimate of cobalt removal efficiencies based on a review of the water quality data, a review of the hydrogeochemical model, and best professional judgement. Specifically, EPA determined that the "Minimum" cobalt removal efficiency should be based on the worst case scenario–hydraulic reductions only and no geochemical reductions. EPA determined that the "Maximum" cobalt removal efficiency should be based on the predictions of the model. The best estimate then fell between the minimum and maximum. The estimates for treatment efficiency for seepage collected at the West Fork Impoundment were also changed to reflect the typically lower treatment efficiencies that can be achieved with passive treatment systems compared to active treatment systems.

Comment 36: *In Section 7.2.1.1 of the FS report and elsewhere in Chapter 7, EPA included a discussion of the uncertainties associated with the predictions made in the modeling of reduced cobalt loads that would be attributable from a soil cover at the West Fork Tailings Impoundment. While the BMSG acknowledges that there is uncertainty in some of the input parameters and assumptions used in the modeling, the analysis shows that reductions in infiltration and oxidation rates will reduce cobalt loadings. Therefore, the EPA's statement in the FS that "It is uncertain whether the cover/cap will be effective at reducing cobalt loads at all" is not correct.*

Response 36: EPA provided extensive comments on the results of the modeling included in Appendix D of the FS. As noted in those comments, with any effort to model complex hydrogeochemical processes, it is difficult to develop a model that can provide accurate predictions of real-world occurrences. This is especially true if the model has been developed using assumptions or default values for many of the input parameters because field information is not available. The BMSG had ample opportunity to collect the field information necessary to provide a properly calibrated model. However, the BMSG chose not to collect additional field information for this calibration. The lack of appropriate calibration means that the outputs from this model, especially for the reduction in cobalt due to the geochemical impacts of the cover at the West Fork Impoundment, have a very large degree of uncertainty. In addition, as noted in Appendix D, any reductions in cobalt loads resulting from the cover may have already occurred. Because of the degree of uncertainty in terms of predicted cobalt load reductions, EPA maintains that it is possible that the cover may result in no significant cobalt load reductions.

Comment 37: *A correct use of the loading reduction information is shown in Table 7-10 of the attached Section 7 of the FS (See Exhibit A). This analysis shows that both BB-6 and BB-7 are predicted to meet EPA's cobalt PRG using "best estimate removal" predictions. Under worst case minimum removal predictions, neither BB-6 nor BB-7 would be predicted to meet EPA's*

PRG. Using EPA's flawed logic, this would mean that neither of the alternatives would be protective.

Response 37: As noted in the response to the BMSG's comment 35 above, EPA does not agree that the removal efficiencies developed by the BMSG are appropriate. Referring to Table 7-10b of the FS, the "best estimate removal" predictions indicate that Alternative BB-7 would meet the cobalt water quality goal in Panther Creek under virtually all normal conditions. However, the predictions included in Table 7-10b indicate that Alternative BB-6 would not meet the cobalt goal in Panther Creek during significant portions of the year. Of particular concern is the prediction for Alternative BB-6 for "Var. Max." under the "best estimate removal" scenarios. The Var. Max predictions are based on percentage reductions from the existing cobalt concentrations typically experienced during the winter and early spring months, when cobalt concentrations in Panther Creek are highest. The predictions in Table 7-10b of the FS indicate that Alternative BB-6 would not meet the cobalt water quality goal in Panther Creek during significant portions of the winter and early spring months.

Regarding the worst case minimum removal predictions, these were developed to provide the "error bars" to define the range of the possible predictions. They are based on worst case scenarios of maximum loadings and minimum removal efficiencies simultaneously, and do not necessarily represent the worst case water quality that could occur in the future. EPA evaluated the alternatives considering all of the information presented in the water quality predictions, recognizing that there is uncertainty in the predictions of potential future water quality for each of the alternatives. EPA judged that it was more likely that Alternative BB-7 will meet the water quality goals on a consistent basis than Alternative BB-6. In addition, EPA judged that it was more certain that the treatment associated with Alternative BB-7 would meet the cobalt water quality goals in an acceptable time frame.

Comment 38: *Finally, as discussed in the FS, it may take a decade or more for the full reductions to be seen from the cover on the West Fork Impoundment. EPA has inappropriately linked the time for achievement of the cobalt PRG to the Consent Decree schedule as a means to essentially disregard the predicted long-term benefits of BB-6 for cobalt removal. Cobalt is not a requirement of the 1995 Consent Decree. The full benefit of the Early Action should be considered from a technical standpoint, without using a predetermined schedule.*

Response 38. Since both copper and cobalt adversely affect a stream's ability to support all life stages of salmonids and related benthic communities, it is important to simultaneously achieve reductions of both metals. Since copper water quality goals are expected to be achieved by 2005 and it is technically practicable to meet cobalt goals by 2005, EPA believes that it is appropriate to implement actions that achieve cobalt reductions in the same timeframe. As noted in Appendix D to the FS, the cobalt reductions resulting from the cover may not be apparent for "years or tens of years". In addition, as noted in the response to the BMSG's comment 36, EPA's position is that it is possible that no additional cobalt reductions may occur as result of the cover. EPA is not willing to allow the cobalt remedial level to be exceeded for years or tens of years to determine when (or if) the cover can be adequately effective.

Comment 39: *As discussed in detail in these comments, EPA's cleanup goal of 38 ug/L for cobalt is arbitrary and unwarranted. The existing concentrations in Panther Creek are consistently below any cleanup goal that can be justified based on site data. Recent fish monitoring performed by the BMSG show that all life stages of salmonids are already supported in Panther Creek downstream of the site. There is no justification for further remedial action to address water quality for cobalt. Moreover, EPA has not shown that the proposed remedial action constitutes "cost effective and reasonable best management practices."*

Response 39: See responses to comments 2, 16, 17, 30 and Appendix C. The ROD shows that the proposed remedial action is cost effective in meeting the threshold criteria of protection of human health and the environment and provides the best long-term effectiveness.

Comment 40: *There is no valid basis for selecting alternative BT-5 for the Bucktail Creek Drainage. EPA's proposed alternative BT-5 includes a pipeline for diversion of Bucktail Creek surface water around South Fork Big Deer Creek. Bucktail Creek currently discharges to South Fork Big Deer Creek approximately one-half mile upstream of its confluence with Big Deer Creek. EPA states that water quality goals could be achieved in South Fork Big Deer Creek under alternative BT-5. However, South Fork Big Deer is not covered by the Consent Decree, and moreover there is no basis for this water quality conclusion. Surface flows in Bucktail Creek greater than the approximately 10-year thunderstorm event would discharge into South Fork Big Deer Creek. As noted in Chapter 7 of the FS report, the discharge of groundwater associated with Bucktail Creek or other sources could prevent the achievement of the extremely low copper WQC in South Fork Big Deer Creek. (See Exhibit A). In fact, natural pre-mining conditions in South Fork Big Deer Creek likely have exceeded the copper WQC.*

Response 40: The fact that the South Fork Big Deer Creek is not covered by the 1995 Consent Decree is irrelevant (see the responses above concerning this issue). EPA must choose alternatives that meet the water quality cleanup levels for the area streams, unless no feasible alternative can be developed that meets those goals and the site meets the criteria for an ARAR waiver. EPA is choosing Alternative BT-5 for the Bucktail Creek drainage, primarily because it is the only alternative that can meet the water quality remedial cleanup levels (which is an ARAR for copper) for the South Fork Big Deer Creek. The water quality predictions for all of the other alternatives indicate that the other alternatives would exceed the water quality remedial cleanup levels by factors of up to about 12 times the remedial cleanup levels (see Table 7-11b in the FS). In addition, Alternative BT-5 is the only alternative that could meet the copper water quality standard, which is an ARAR.

It is true that surface flows in Bucktail Creek greater than approximately the 10-year storm event would be discharged to the South Fork Big Deer Creek. However, the 10-year design event is the threshold. In other words, Bucktail Creek flows would not be discharged until flows exceeded the design capacity of the bypass pipeline. Thus at flows in excess of the 10-year event, most of the Bucktail Creek flows would still be bypassed around the South Fork Big Deer Creek. It would take an event considerably larger than the 10-year event to result in significant Bucktail Creek overflows to the South Fork. As noted in Chapter 7 of the FS, these overflows would occur during times when the flows in the South Fork would likely be significantly higher than normal. Thus the increased South Fork flows would likely provide additional dilution, such that the effects on water quality would be minimized and of short duration.

Chapter 7 of the FS indicated that groundwater or other sources could prevent achievement of the water quality goals in the South Fork Big Deer Creek, even after natural recovery of the in-stream sediments. However, Chapter 7 also indicated that, if these sources resulted in future exceedances of the water quality remedial goals, EPA would evaluate contingencies to address the groundwater or other sources.

There is no evidence that natural pre-mining conditions resulted in exceedances of the water quality standard in South Fork Big Deer Creek. In fact, recent water quality monitoring at the background station on the South Fork (upstream from Bucktail Creek) indicates that metals concentrations are consistently below detection limits (except for some samples with questionable QA/QC).

Comment 41: *No environmental benefit would be gained by attempting to achieve water quality goals in South Fork Big Deer Creek. Recent fish sampling performed by the BMSG found no fish in South Fork Big Deer Creek upstream or downstream of Bucktail Creek. It is poor fish habitat. Natural physical barriers (log jams and water falls) inhibit the colonization of fish in South Fork Big Deer Creek from Big Deer Creek. (See Exhibit C, Beak/Golder 2002). Disturbance of the Bucktail Creek drainage due to performing BT-5 would likely to be more harmful than the status quo.*

Response 41: The NCP obligates EPA to meet or waive the State water quality standard for copper ARAR as a threshold criteria. An ARAR waiver cannot be justified. EPA believes that the BMSG failed to find fish in the South Fork of Big Deer Creek downstream of Bucktail Creek due to levels of metals in the surface water that are toxic to fish, rather than due to any habitat limitations. The absence of fish in the South Fork upstream from Bucktail Creek may also be due to the significant migratory barrier caused by the metals from Bucktail Creek. The South Fork of Big Deer Creek is a sufficiently large stream that it could provide habitat for some small fish as well as for macroinvertebrates. Furthermore, the information provided in Exhibit C indicates that some habitats are rated as moderate rather than poor and that physical barriers would not preclude fish colonization of South Fork of Big Deer Creek. Therefore, the water quality remedial goals are applicable to the South Fork Big Deer Creek. The environmental disturbance to the Bucktail Creek drainage resulting from construction of a buried pipeline along an existing roadway would be minimal, temporary, and easily mitigable.

Comment 42: *There is a possibility that placing Bucktail Creek in a pipeline could actually increase copper concentrations in Big Deer Creek. South Fork Big Deer Creek historically acted as a sink for dissolved copper that was released from Bucktail Creek. The Early Action reduced copper loading such that reductions in copper concentrations in South Fork Big Deer Creek have not been observed in recent years. Over the long term, natural removal processes such as precipitation reactions or adsorption of copper onto sediments or organic materials can be* *expected to result in a net loss of dissolved copper in South Fork Big Deer Creek. These process would not be likely to occur in a pipeline that, under alternative BT-5, would convey Bucktail Creek water to Big Deer Creek. In summary, the additional cost and environmental disturbance that would be caused by construction of a pipeline under alternative BT-5 is not justified.*

Response 42: EPA disagrees that bypassing Bucktail Creek around the South Fork Big Deer Creek would result in increases in copper concentrations in Big Deer Creek. The geochemical processes (such as precipitation and adsorption) that reduced copper concentrations in the South Fork of Big Deer Creek, occurred primarily prior to the Early Actions, when concentrations of copper were much higher in the South Fork. As noted in the comment, since the completion of the Early Actions, copper reductions have not been observed along the South Fork Big Deer Creek, probably because the copper concentrations in the water column no longer exceed the solubility limits for the typical precipitates. The implementation of the remedial actions will further reduce the copper concentrations in Bucktail Creek waters. This means that it is very unlikely that significant reductions in copper concentrations would be observed along South Fork Big Deer Creek (due to precipitation and/or adsorption) if one of the other action alternatives were selected by EPA.

The additional cost of construction of the bypass pipeline is small compared to the cost estimates for the overall remedial actions (approximately 6 percent of the estimated total net present worth of Alternative BT-5). The bypass pipeline would be constructed along or within an existing roadway for much of its length. Thus, the environmental impacts of pipeline construction would be short term and would be mitigated comparatively easily.

Comment 43: *In Section 6 of the FS, EPA has included possible "contingent actions" that might be evaluated by EPA if the selected actions do not meet remediation goals in an acceptable time frame. This type of 'catch all' listing of contingent actions is not appropriate. As discussed in the forgoing comments, the actions already performed at the site have made major reductions in the metals releases from the site and may already provide protection of all life stages of salmonids in Panther Creek.*

Through identification of contingent actions in the FS and the proposed plan, EPA appears to be planning on a never-ending series of follow-up studies for employment of its staff and contractors. Operation and maintenance and monitoring requirements for the Early Action and additional work already performed by the BMSG will ensure that the system continues to operate as designed.

Response 43: See response to Comment 12. The contingent actions are not related to operation and maintenance or ensuring that the system continues to operate as designed. As noted in the FS and the ROD, there is uncertainty concerning the predictions of effectiveness of some of the remedial actions, particularly relative to the water quality. The contingent actions would be evaluated only if the remedial actions do not consistently meet the remedial cleanup levels.

Comment 44: *The goal is the protection of all life stages of salmonids in Panther Creek and Big Deer Creek. That goal is being achieved as evidenced by the report of fish populations in Panther Creek. Achievement of this goal is more important than the achievement of arbitrary surrogate numeric cleanup levels, which we dispute. Any future actions should not be based on the absolute achievement of numeric cleanup levels, but rather on sustaining salmonids in Big Deer Creek and Panther Creek.*

Response 44: One of EPA's remedial action objectives is protection of all life stages of salmonids in Panther Creek and Big Deer Creek. EPA does not agree with the BMSG's fish study conclusions and how the BMSG is using the conclusions of the fish study (see other EPA responses on the fish study and Exhibit C). In order to achieve the above remedial action objective, EPA established a range of measurable standards, including biological goals, narrative goals and numeric goals. The numeric goals that are being required for this cleanup are required by federal and state ARARs. The copper cleanup level is established by the State water quality standards. The cobalt cleanup level is established through a risk-based analysis. This analysis is necessary to establish a cleanup level that assures protection of human health and the environment. It is also necessary to establish a numeric cleanup level to satisfy the NPDES requirements of the CWA.

Comment 45: *EPA also made arbitrary changes to Section 3.1.1.1.3 and other sections of the FS regarding the applicability of NPDES requirements to discharges from the Blackbird Site. NPDES is an applicable requirement to discharges from the water treatment plant and the culvert discharge from the West Fork Tailings Impoundment. Both of these discharges are to Blackbird Creek not to Panther Creek. The beneficial use designation for Blackbird Creek is secondary contact recreation, not cold water biota. Existing standards for the treatment plant, which are set at technology-based limitations (and the discharge from the impoundment culvert), meet the secondary contact criteria in Blackbird Creek. No further analysis should have been required by EPA to assess compliance with NPDES requirements. Nevertheless, as part of the evaluation of alternatives in the FS, EPA required that we conduct mixing zone analyses (Appendix B in the FS) to evaluate whether alternatives could sufficiently reduce copper concentrations from all sources (not just the point sources subject to NPDES requirements) discharging into Blackbird Creek. This was done to address FWQC in Panther Creek, not Blackbird Creek. This type of mixing zone analysis is a misapplication of the NPDES requirements. Mixing zone analyses are intended to be used for point source discharges into receiving waters, and not for evaluations of one creek mixing with another creek.*

Response 45: The Clean Water Act (CWA) requires an NPDES permit for all point sources that discharge pollutants to waters of the U.S. Point sources include any discernible, confined and discrete conveyance from which pollutants are or may be discharging. This includes, but is not limited to, discharges from the water treatment plant, the Westfork Tailings Impoundment and other contaminated materials.

The CWA and NPDES regulations require that effluent limitations in the permit must be stringent enough to maintain state water quality standards. Effluent limits, therefore, are developed based upon the water quality criteria that is protective of the use of the receiving water. The Blackbird mine site point sources discharge directly to Blackbird Creek, therefore Blackbird Creek is the receiving water of concern. Panther Creek is also a receiving water of concern since Blackbird Creek flows into Panther Creek just a few miles below the point source discharges. Effluent limits in NPDES permits must be protective of the beneficial use of the receiving water and any more stringent downstream uses.

The Idaho state water quality standards specify the beneficial use of Blackbird Creek as recreational and the beneficial use of Panther Creek as cold water biota. Currently the concentrations of copper and cobalt in Panther Creek exceed water quality criteria (copper) and risk-based criteria (cobalt) that is protective of the cold water biota use.

The traditional approach under the CWA for addressing point sources in impaired waters is to develop a total maximum daily load for the impaired water body. The TMDL allocates individual wasteload allocations for each point source that discharges to the water body. The wasteload allocations are then incorporated as effluent limitations in the NPDES permits for the point sources. Where a TMDL is not available, as is the case for Panther Creek, effluent limits are developed based on meeting water quality criteria at the point of discharge. In other words, no mixing zone is allowed. No mixing zone is allowed since the receiving water(s) already exceed the criteria and therefore no "clean" water is available to dilute an effluent that discharges at concentrations higher than the criteria. Rather than using this traditional approach, EPA is proposing to allow a mixing zone in Panther Creek for the discharges, since Panther Creek is expected to meet water quality standards after the cleanup of the Site.

A mixing zone was appropriately applied to calculate acceptable loading from the point sources in Blackbird Creek to Panther Creek. This mixing zone must allow an adequate zone of passage for fish and must be carefully monitored.

Comment 46: *EPA has previously concluded that the extensive removal actions already performed for Panther Creek overbank deposits prevent risks to human health under current uses. However, EPA postulates that, under hypothetical future residential use scenarios, very low future risks on several private properties could occur. As the BMSG has extensively commented in the past, EPA's method of calculating potential risks seriously overestimates any risks posed by the low concentrations of arsenic that remain in these remote overbank deposits. EPA's exposure assumptions make the unrealistic assumption that all of a person's outside residential activities would occur only on these selected locations. This is not realistic. The BMSG does not agree that any further removal actions or institutional controls are needed for the Panther Creek overbank deposits.*

The BMSG has submitted comments throughout the HHRA process at the site (see Exhibit H, comment letters dated March 26, 1998, July 21, 1998, February 22, 1999, March 24, 1999, June 18, 1999, September 27, 1999, June 28, 2001, August 14, 2001). For the most part, EPA has not responded or disagreed with these analyses submitted by the BMSG, but the HHRA is nonetheless inconsistent with the conclusions reached in the BMSG comments.

Response 46: The exposure areas that were evaluated for the Panther Creek overbank deposits represent areas that may be contacted regularly by human receptors. Although some of these exposure areas are small, they are located in areas that may be attractive to children playing by Panther Creek or other recreational users of the creek. The goal of the HHRAs is to estimate risks for reasonable maximum exposure conditions. Since it is possible that children or other receptors may limit their activities to these designated areas along the creek, risks were calculated for these exposure areas as a reasonable maximum exposure scenario. Using these reasonable maximum exposure assumptions, potential future risks for three private properties (assuming full-time residential use of the properties) exceed EPA's acceptable risk range. Therefore, future removal actions or institutional controls are needed for these properties.

Numerous meetings and conference calls were held between EPA and the BMSG about the exposure assumptions used in the HHRAs for the Panther Creek Inn and the Panther Creek overbank deposit areas. These meetings and conference calls included discussions about the exposure area data groupings.

EPA disagreed with the BMSG's recommendations for exposure assumptions during these meetings and conference calls and consequently, EPA did not change the exposure area assumptions used in the risk calculations. However, based on the BMSG's comments, text was added to the uncertainty section of the HHRAs to explain the uncertainties associated with risk estimates based on small exposure areas.

Comment 47: *The BMSG has commented on the unrealistic assumption of 60% bioavailability and has provided site-specific data (2 separate studies) documenting lower bioavailability at the site (Golder 1996 and Exponent 1998). The in vitro biaccessibility study conducted by Exponent indicated that the probable site-specific relative adsorption factor for arsenic is no higher than 0.13, indicating an approximate 5-fold overestimation of potential risk using EPA's adsorption factor of 0.60.*

Response 47: EPA has included a discussion of the site-specific bioavailability studies that were conducted by Exponent for the BMSG in the uncertainty section of the HHRA. As stated in the HHRA, no corresponding animal studies were conducted with these in-vitro bioavailability studies. Because of the limitations of these site-specific studies (no corresponding site-specific animal studies), the results were not used in a quantitative manner in the HHRA. The uncertainties associated with using the EPA Region 10 default value (0.60) in the risk calculations was discussed in the uncertainty section of the HHRA.

Comment 48: *Most of the soil samples from within the exposure areas evaluated in the risk assessment were originally collected to determine the presence or absence of mine-related materials. As such, the samples were collected in depositional zones or other areas most likely to contain mine-related materials and elevated metal concentrations, ignoring areas where the presence of mine-related materials was unlikely. These samples were biased toward locations with higher metals concentrations and are not representative of the larger exposure areas evaluated in the risk assessment. For example, in the assessment of potential future residential* *scenario, EPA assumes that the entire exposure period for future residents would occur on the few small depositional areas where arsenic concentrations exceed 100mg/Kg. This is not a realistic assumption.*

Response 48: See the response to the BMSG's comment 46 for a discussion of this issue.

Comment 49: *In previous comments, the BMSG and its consultant, Exponent, have recommended that the assessment of short-term noncancer risk to young children should incorporate a short-term reference dose for arsenic rather than the chronic reference dose based on lifetime exposure. Since our previous comments, discussion of a short-term arsenic reference dose for children has been elevated to a national level and several additional evaluations and reviews of a short-term reference dose for arsenic have been released. All of these evaluations recommend a short-term reference dose for less than 7 years of exposure that is about 10 times higher than the dose (0.0003 mg/kg-day) used by EPA Region 10 in its risk assessment for the Blackbird Mine.*

These current studies include a review by EPA Region 8 (2001), aided by an EPA/ATSDR Interagency Work Group, which received external peer review from three scientists. (See Exhibit I, Arsenic Toxicity Factor References). This review recommended a lowest-observed-adverse-effect level (LOAEL), of 0.05 mg/kg-day and an acute and subchronic reference dose of 0.015 mg/kg-day for less than 7 years of exposure. A national recommendation for the short-term reference dose is currently being considered by EPA under the direction Dr. Peter Grevatt.

A short-term reference dose for arsenic was also considered by EPA's FIFRA Science Advisory Panel in October 2001 in evaluating the short-term risks of arsenic exposure from treated-wood play structures to children (See Exhibit I, Odiott and Roberts 2001). The panel recognized a high level of confidence in 0.05 mg/kg-day as a LOAEL, based on the scientific literature. The panel's recommendations for a protective level for children was a short-term reference dose of either 0.002 or 0.005 mg/kg-day.

A more recent evaluation of the literature was presented this summer at the 5th International Conference on Arsenic Exposure and Health by scientists from Exponent, EPA, Gradient, and the local health agency in Denver (See Exhibit I, Tsuji, et al. 2002). The findings of this review were that based on the LOAEL of 0.05 mg/kg-day, a protective level for children would be no less than 0.005 mg/kg-day.

Response 49: As noted in the comment, a national recommendation for the short-term reference dose for arsenic is currently being considered by EPA. However, at this time, there is not yet a recommendation from EPA at the national or Region 10 level of the appropriate value to use for a short-term reference dose for arsenic. The suggested short-term reference doses described in this comment have not been officially adopted by EPA and guidance has not been published for their use. Therefore, it is not appropriate to use these values in the estimation of potential noncancer health effects from arsenic at the Blackbird Mine Site. Irrespective of which reference dose is used, a potential cancer risk is shown at the three private properties along Panther Creek, as discussed below in the response to comment 50.

The sub-chronic reference dose report is based on a *Lowest Observed Adverse Effect Level* (LOAEL) for skin lesions at a dose of 0.05 mg/kg-day. Two uncertainty factors were applied to this LOAEL to derive the recommended sub-chronic reference dose (RfD) of 0.005 mg/kg-day (i.e., one-tenth of the LOEAL). The uncertainty factors were based on inferring a *No Observed Adverse Effect Level* (NOAEL) from the LOAEL and limitations of the database including the potential for neurological and cardiac effects.

There are specific concerns regarding the protectiveness of applying the sub-chronic oral reference dose to childhood exposures. Studies describe five fatalities in children aged 2-7 years at doses estimated between 0.05 - 0.13 mg/kg-day. Additional concerns are based on prolonged cardiac dysrhythmia and liver dysfunction following intravenous infusions of arsenic trioxide in acute promyelocytic leukemia patients at doses of 0.06 - 0.12 mg/kg-day. Because these fatalities and other serious adverse health effects occur in young children at, or close to, the LOAEL for skin lesions, it is reasonable to question the protectiveness of the sub-chronic RfD.

Comment 50: *The correct application of the above information by EPA in the Human Health Risk Assessment would show that the future residential use scenario for Panther Creek properties would not result in unacceptable potential future risks. As such, there is no need to consider future removal actions or institutional controls on Panther Creek properties.*

Response 50: Three private properties along Panther Creek have concentrations of arsenic that result in risk estimates that exceed EPA's acceptable risk range for the future full-time residential scenario ([redacted] [redacted] /[redacted] and [redacted]. Both the potential cancer risks and noncancer Hazard Indices exceed EPA's acceptable ranges (i.e., 1 x 10^{-6} to 1 x 10^{-4} for potential cancer risks and a Hazard Index of 1 for potential noncancer health effects). Use of the subchronic reference dose for the child scenario would not affect the potential cancer risk estimates; these potential cancer estimates would still be greater than 1 x 10^{-4}. Therefore, additional actions or institutional controls are required to address the unacceptable potential cancer risks.

Comment 51: *BMSG comments on EPA's Aquatic Ecological Risk Assessment referenced above have shown that the toxicity reference values used in the evaluations of potential risks posed by sediments were unrealistically low. The cobalt reference value was based on a single data point, an approach which is not sufficient to evaluate toxicity thresholds. Literature values for arsenic and copper were used incorrectly in the risk assessment as potential indicators of risk when those values could only appropriately be used to rule out probable effects (see June 29, 2001 comments, Exhibit D). The risk assessment failed to consider that metals in site sediments were likely to have very low bioavailablity based on their presence as sulfides or their adsorption or co-precipitation with iron oxides, organics, or other materials. The unrealistic reference values were further evidenced by the fact that background concentrations of arsenic, copper and cobalt each exceeded the toxicity reference values in the risk assessment.*

Recognizing the presence of background concentrations of metals, EPA set cleanup levels based on a consideration of background rather than on the assessment of risks. However, the cleanup levels fail to consider the full range of background concentrations. As such, the cleanup levels frequently exceed natural background concentrations of metals. Furthermore, the risk assessment process failed to establish that any risk is posed to aquatic organisms if the background concentrations are exceeded. There is an implication in the proposed plan that a risk from sediments exists if metals concentrations exceed the cleanup levels. That is simply not the case.

EPA has acknowledged in its own risk assessment that risks from sediments are unlikely. In the July 17, 2001, draft final Aquatic Ecological Risk Assessment, CH2M Hill stated for both Panther Creek and Big Deer Creek that "based on the low dietary HQs and the uncertainty associated with establishing background UTLs ..., it is unlikely that sediments are causing potential adverse effects to the aquatics system." EPA and/or CH2M Hill deleted this acknowledgement as to Panther Creek without explanation in the final risk assessment issued on August 27, 2001. However, the same discussion for Big Deer remained in the final document.

The alternatives proposed by EPA rely primarily on natural recovery of in-stream sediments. The BMSG agrees that this is the correct approach for in-stream sediments. However, the proposed plan should make it clear that there is no known risk to aquatic organisms at the concentrations currently existing in the in-stream sediments.

Response 51: EPA has discussed the sediment toxicity reference values in the Aquatic Ecological Risk Assessment at length with the BMSG, in both meetings and conference calls. The best available data were used to develop sediment toxicity reference values. Different approaches were considered. EPA considers that the sediment toxicity reference values were used appropriately. There is inadequate evidence to support the BMSG's claim regarding bioavailability. The BMSG could have conducted sediment toxicity bioassays to reduce uncertainty but apparently chose not to do so.

The fact that the upper tolerance limit for background concentrations of arsenic, copper, and cobalt exceeded their respective toxicity reference values is not evidence that the toxicity reference values were inappropriate. It is, in fact, possible that there are some locations where naturally occurring levels of metals could produce adverse biotic effects. This does not mean that the toxicity reference value(s) is inappropriate. However, it is appropriate for EPA to consider the ambient conditions in establishing cleanup levels. Generally, under CERCLA, cleanup levels are not set at concentrations below natural background levels.

EPA set sediment cleanup levels considering background concentrations including evaluation of potential risks. The background concentrations did consider the full range of potential background values based on data available at the time.

It was not the intent of the risk assessment to determine risk due to background concentrations, rather the risk assessment attempted to determine acceptable metal concentrations in the environment regardless of source (i.e., whether they were background or site related concentrations). EPA notes the additional discussion regarding the aquatic risk assessment, and that the BMSG agrees with the EPA's plan to allow for natural recovery of in-stream sediments. However, the data simply are not adequate by which to state with any justification that there is no known risk to aquatic organisms due to exposure to in-stream sediments. EPA has proposed natural recovery of in-stream sediments with the knowledge that hydrologic and geochemical conditions existing in Panther Creek and Blackbird Creek will eventually reduce sediment concentrations.

Comment 52: *The State of Idaho and the United States on behalf of the EPA and other federal agencies brought lawsuits seeking injunctive relief, response costs and damages relating to Blackbird Mine. Those claims were resolved in a global settlement that was, after notice and a public comment period, approved by the Court in 1995. The BMSG agreed to undertake certain obligations specified in the Consent Decree, and in return the United States and the State agreed to release the BMSG with respect to all matters raised in the lawsuits. See ¶¶ 5 and 85.*

Paragraph 5(c) of the Consent Decree is very specific concerning the obligations of the BMSG with respect to water quality. It provides that the water quality standard for copper as set forth in the BRCP shall be achieved by 2005 to achieve a level of water quality in Panther Creek and Big Deer Creek sufficient to sustain salmonids through all life stages.

A consent decree is a court order embodying the terms agreed upon by the parties as an alternative to litigation. It is well settled that "consent decrees are construed as contracts" and are enforced as such. Consequently, if a party breaches a term of a consent decree, that action is a breach of contract. If EPA were to utilize the FWQC to establish different cleanup goals for copper in surface water, or to add pollutants or streams not described in the Consent Decree, and thereby to attempt to materially and unilaterally change the obligations of the BMSG, that would be a breach of contract.

The Consent Decree was entered into between the parties after extensive negotiation generated agreement over the precise terms. Consent decrees embody the compromises of the parties and the meaning of the decree is ascertained by looking within the four corners of the document. Further, when interpreting the requirements of a consent decree, "the explicit language of the decree is given its plain meaning and is afforded great weight."

EPA's proposed plan goes well beyond the requirements of the 1995 Consent Decree, in terms of pollutants covered, specific standards, and water bodies covered. The 1995 Consent Decree resulted from a consensus that appropriate water quality goals should focus on attaining copper standards in Panther Creek and Big Deer Creek. A considered decision was reached not to address other streams, such as Blackbird Creek, where attaining water quality goals was not deemed feasible. Similarly, the Consent Decree imposes obligations only with respect to copper, not other pollutants.

In contrast, EPA's proposed plan contains water quality goals for cobalt and arsenic, pollutants not specified, and addresses streams such as Blackbird Creek and South Fork Big Deer Creek that are not specified in the Consent Decree.

When the 1995 Consent Decree was negotiated, the BMSG also negotiated a presumptive remedy, called an Early Action, which was set forth in a separate 1995 Administrative Order on Consent (AOC). The Early Action agreement and the Consent Decree, taken together, were intended to define the BMSG's obligations. The Early Action represented the best judgment of the BMSG and EPA, with the approval of the Trustees, regarding the response actions necessary to achieve the water quality goal for copper set forth in the Consent Decree. The Early Action process was used, rather than a Record of Decision (ROD), in order to expedite cleanup actions at Blackbird Mine and in particular to improve water quality for copper sufficient to sustain salmonids in Panther Creek and Big Deer Creek.

The BMSG recognized that EPA would probably wish to issue a ROD in the future, but the expectation of the BMSG and the agencies, as discussed in the negotiations, was that the ROD would conclude that no further action was necessary, based on the work performed in the Early Action. The issuance by EPA of a ROD was left open as an option to "fine tune" or supplement the Early Action if needed to address the water quality goals in the Consent Decree, namely to attain water quality for copper sufficient to sustain salmonids in Panther Creek and Big Deer Creek. It was not contemplated by the BMSG that EPA would embark on a lengthy, expensive, open-ended Superfund process that ignores or supercedes the goal of creating water quality for copper sufficient to sustain salmonids in Panther Creek and Big Deer Creek. It was not contemplated by the BMSG, nor expressed by any of the governmental representatives, that the ROD might change the water quality standard for copper, or impose requirements for pollutants other than copper, or require remediation of streams other than Panther Creek and Big Deer Creek. In short, the ROD was not intended to change the requirements of the Consent Decree.

That is not to say that EPA has no authority or options. EPA may elect to address pollutants or streams not covered by the Consent Decree and implement remediation for those pollutants and streams using monies provided by the U.S. Superfund fund and the State. Alternatively, using the modification provision of the Consent Decree, ¶¶ 93 and 94, the Consent Decree may be modified by agreement of all of the parties. However, EPA may not unilaterally impose new obligations upon the BMSG.

Response 52: As discussed in previous responses to comments, EPA disagrees with the BMSG's representations and interpretations of the 1995 Consent Decree and the Administrative Orders. In the 1995 Consent Decree, the BMSG agreed to perform both response actions and restoration actions at the Site. The 1995 Consent Decree focuses on the restoration goals and clearly recognizes that the remediation of the site will be performed by the BMSG separately pursuant to separate administrative orders or consent decrees not covered by the Consent Decree. As further mentioned in above responses, the 1995 Consent Decree does not limit EPA's responsibility to select a response action for this Site and that such response action is expected to comport with the requirements of CERCLA.

Comment 53: *In conclusion, EPA's plan is inconsistent with the 1995 Consent Decree and ignores the significant benefits produced by the Early Action and additional work undertaken by the BMSG. It is based on arbitrary remediation goals not justified to sustain salmonids. EPA compounds its error by using erroneous (in the case of cobalt) and nonexistent (in the case of arsenic) analyses of the performance of remedial alternatives.*

Response 53: See all the responses to comments above.

EPA Responses to Exhibit C

General Response:

The BMSG conducted a fish study in August 2002. The results of that fish study can be found in Exhibit C of the BMSG's comments and are not reproduced in this responsiveness summary. There are numerous and serious limitations regarding the BMSG's fish study as it is presented in Exhibit C. With these limitations, the conclusions made by the BMSG from the data presented in this Exhibit are unsubstantiated. EPA does not agree with the conclusions of the fish study. The limitations of the fish study are enumerated in the General and Specific comments below.

1. The BMSG's fish study was conducted without EPA oversight and without a workplan approved by EPA. Performance of a fish study was discussed between the BMSG and EPA in two meetings during the spring of 2002. EPA stated in the meetings that such a study would be useful in establishing post-early action and pre-remedial action conditions and should be performed under EPA oversight as part of the CERCLA process (i.e., 1994 RI/FS AOC). The BMSG failed to notify EPA of their plans to perform the study and did not involve EPA and other stakeholders in the planning and implementation process. Therefore, the data cannot be considered impartial.

2. The methodology as presented is inadequate to determine if appropriate quality assurance procedures were followed. The methodology as presented is also inadequate to determine why some locations were sampled quantitatively while others were sampled qualitatively.

3. The data presented are inadequate to determine if the study is conclusive, or even suggestive. For example, while the BMSG states that dietary preferences were investigated by analyzing some fish unintentionally killed as the result of electroshocking, it is unknown how many fish of each species were analyzed. There are no statistics presented; therefore, it is unknown how reliable these results might be. It is therefore unknown if enough fish were collected to make a definitive statement regarding feeding habits. Thus, while the BMSG's data are indicative of improved conditions, the data are definitely not conclusive that Panther Creek and Big Deer Creek are capable of supporting all life stages of salmonids.

4. Prior to the fish survey there was a failure in the outlet structure of the clean water reservoir on upper Blackbird Creek. This failure released potentially large numbers of fish downstream.

This release confounds the BMSG's fish study, as it could skew the population data significantly. This release is not discussed in Exhibit C.

5. The data in the fish study represent only one sampling point in time. Because of this, the data are not sufficient evidence to determine the current or future state of fish populations in the impacted area creeks.

6. Water quality data apparently were not collected in conjunction with the fish data. Metal concentrations are low in August in Blackbird and Panther Creeks, the time during which the fish survey was conducted. This could have affected the status of fish populations in Blackbird and Panther Creeks. The fish study data are inadequate to determine if fish occupy these habitats year round, or if peak concentrations of cobalt or copper produce elevated levels of mortality or morbidity, temporarily reducing populations or altering fish communities.

7. The BMSG fish study found several types of salmonids in Panther Creek, including Chinook salmon. There was a large release of adult Chinook salmon in 2001 for angling, and these fish apparently spawned. The rate of spawning success is unknown, and the location of the redds that successfully produced young is unknown. For any study to be meaningful for conclusions regarding Chinook salmon reproductive success, several generations would have to be studied. Natural fish populations must demonstrate that they can reproduce successfully from year to year in Panther Creek. Repeatability is very important for any type of population survey. The BMSG also found, handled, and photographed an adult wild Chinook. This was possibly outside of the legal limitations regarding their collection permit, which specifies that these animals shall not be harassed.

8. There are several factors that may mask or confound relating fish populations to metal concentrations:

- Upstream-downstream changes in fish habitat, temperature, etc. Streams change upstream to downstream and so do their uses by fish;

- Evaluation of appropriate reference sites on different but similar streams (e.g., tributaries to the Salmon River) in addition to the upstream-downstream comparisons would provide more definitive results. The study did not include a reference drainage(s) with similar habitat for comparison, which severely limited its usefulness and precludes drawing the conclusions at the end of Exhibit C;

- The report makes unfounded statements regarding the distribution of spawning and juvenile Chinook salmon. Spawning could have been affected by temperature or salmon could have spawned but none survived due to metal concentrations. The distribution of fish does not necessarily reflect the distribution of spawning;

- Sculpin are probably a better instream indication of metal contamination in streams than are trout. Sculpin need to be sampled by electrofishing, and not by snorkeling; thus, this weakens any comparisons to the IDFG data to establish trends over time.

9. It is important to consider the populations of other fish and macroinvertebrates in addition to salmonid populations when making decisions regarding Panther Creek and mining-related impacts. Macroinvertebrates and sculpin would serve as better bioindicators or sentinels of ecological effects since salmonids can be highly migratory, making it difficult to interpret chronic toxicity, presence/absence, and other population effects. Less mobile species are better reflective of site or local conditions.

Specific Responses:

Page 1. A reference was lacking for the IDFG redd count and chinook salmon stocking. Information regarding redds and their locations is critical to evaluating salmonid reproductive success.

Page 3. First Paragraph. The methodology regarding fish surveys was not explicit. For example, the first paragraph states that survey work in Panther Creek was conducted using standard methods for estimating fish populations and fish condition as well as for assessing stream habitat. The references for these methods were not provided. The exact method applied to estimate fish populations, estimate fish condition, as well as assess stream habitat, was not stated. It is not clear if similar habitats were sampled at each site, and it is not clear that a uniform method such as a consistent unit of effort was used at each site. The data are not necessarily comparable between locations, since similar collection methods and sampling efforts in water bodies of similar size must be performed. These limitations and their potential impact on the resulting data and conclusions are not discussed.

It is not clear if the major habitats (riffle, pool, run) were sampled at each location; it is not apparent if the proportion of each habitat type sampled were comparable between locations. Precision, accuracy, and completeness of the data were not evaluated. Replicates were not collected in order to define variability. Data reproducibility was not determined. From the text throughout the results section, it appears that locations above points of confluence with Blackbird Creek were relied upon as 'reference' locations. However, this was not clear and was lacking in the Methods section. The selection process of the various locations for reference locations is critical in performing any data comparisons for effects analysis. Because this information was lacking in the methodology, the adequacy and representativeness of the results cannot be determined, and the conclusions are misleading and uncertain.

Page 3. Fourth paragraph. This paragraph states that quantitative sampling was carried out by sampling 150 to 300 square meter sections of the creek. The text is not clear concerning how locations were selected for qualitative versus quantitative sampling. The methods failed to state how the size of the section sampled was selected and the effect of the number of passes of the backpack electrofisher on the resulting data.

Page 3. Fifth paragraph. This text failed to describe the methods for scale collection, and the quality assurance methods that were applied. The location of scales collected for salmonids is critical for the aging process. Random duplicates are critical to the QA process as well, and apparently were not collected.

Page 3. Sixth paragraph. It is not clear as to the methods for the qualitative sampling that were applied. The decision process for identifying locations for quantitative vs qualitative evaluation was not stated. The supporting data for the qualitative locations is not provided since the Appendices only provide the quantitative information. This paragraph indicates that additional locations for qualitative analysis were identified, in order to capture habitats not characterized in the quantitiative stations. However, the text does not indicate which habitats were missed in the quantitative locations. The rationale for location selection was not clearly described.

Page 3. Seventh paragraph. The report failed to explain how specimens were selected for weighing and measurement. It is unclear if this process was random or if this could have introduced significant bias into the results. The records for the sweep electrofishing seconds by sampled reach were not provided.

Page 3.5. Figure 1. The information concerning why a significant number of the PAF upstream locations (CCFO.1, PAF39.7, PAF36.2, PCF0.1, MCF0.1) were identified as 'qualitative' sampling locations was not provided.

Page 4. First paragraph. While the fish condition method appears relatively straight forward, the reference for this method was not provided, nor any comparison to other methods to justify selection of one method as opposed to another.

Page 4. Third paragraph. The methods applied to the habitat surveys are not clear. If habitat surveys are going to be used to justify the population level effects, this information is critical. It is not clear what level of effort was expended to perform habitat surveys. While qualitative ratings are used to describe the spawning, rearing, overwintering, and adult feeding and holding habitats, it is not clear what the scale is for these ratings. This appears highly subjective. In addition, within this paragraph defined measures of instream cover, substrate composition and habitat composition were described. However, it is not clear how these measures were incorporated into the study results of 'Fish Habitat' (page 9). It appears that these measures were never interpreted in the results presented in the study.

Page 5. Fourth paragraph. The comparison of this electrofishing study to the IDFG snorkel study does not make sense. The methods, objectives, and resulting data from the two studies are distinctly different. There is no purpose to complete this type of comparison.

Page 5. Last paragraph. The information regarding fish densities with respect to the water treatment plant discharge was not clear. Densities are presented for periods when the treatment plant was not discharging and for time periods when the effluent was present, but there is not enough information provided to determine if this is meaningful. Confounding factors include the effluent discharge over time prior to the fish sampling effort, how long the treatment plant had been discharging when density data were collected, and the period of time that was allowed to elapse after discharge ceased before density data were collected again.

Beginning with this subsection (3.2.1), and continuing with each tributary subsection (3.2.2 through 3.2.3), the qualitative locations identified in each tributary were not described. The rationale for the selection of the qualitative locations (presumably to characterize a habitat type not sampled within the quantitative locations, but this is not described) was lacking. It appears that the South Fork of Big Deer Creek was entirely qualitative characterized. There are no supporting data within the Appendices to Exhibit C to support these findings.

Table 4. The biomass value for 'All Fish' for the Panther Creek PAF24.0 location value was not presented in the raw data provided in Appendix 3. This value could not be verified.

Page 6. The third paragraph indicates that benthic macroinvertabrates appeared to be sparse in Blackbird Creek. The text states that fish condition did not appear to be affected. It is unknown how long these fish had been in Blackbird Creek. The statement does not indicate how many fish were measured for condition. The release from the clean water reservoir upstream could have released numerous healthy fish into Blackbird Creek, as well as diluted surface water metal concentrations. These are confounding factors that severely compromise the results and conclusions.

Page 6. Fifth paragraph. Downstream of South Fork of Big Deer Creek, trout densities were lower despite the occurrence of apparently good habitat conditions. This is likely the result of metal loading from the South Fork of Big Deer Creek. The next paragraph is conflicting as it states that trout were abundant in Big Deer Creek, except where the South Fork empties into Big Deer. EPA notes that this strongly suggests that the South Fork of Big Deer Creek is impacting water quality and fish habitat in Big Deer Creek.

Page 7. Sculpin were absent at station PAF10.4 which is downstream of the mouth of Big Deer Creek. This, coupled with the paucity of number and diversity of fishes in Big Deer Creek below the South Fork, indicates water quality problems persist in Big Deer Creek.

Page 7. With regards to biomass measurements, it is possible that the fish had only been in Blackbird Creek for a few days or weeks, seeking thermal refuge. Rainbow trout and Chinook salmon are fairly mobile, and can exhibit migratory movements. The data are inadequate to determine fish movement and the corresponding duration of exposure. Biomass measurements are standardized to 100 square meter areas, although the size of each location sampled differed significantly. It is unclear how the variation in the size of the area sampled affected the results.

Page 7. First paragraph. The statement that fish likely entered Big Deer Creek from Panther Creek, indicating Big Deer Creek was not causing a strong avoidance reaction at the time of sampling, is not justified. Chinook salmon density was lower in Big Deer Creek than in Panther

Creek. Chinook density was lower than upstream areas as well.

Page 7. Second paragraph. The densities of fish from the South Fork of Big Deer confluence to station SFF0.5 upstream of Bucktail Creek were obviously influenced by metal loading. Despite the fact habitat conditions were considered to be poor, metal loading was the most significant factor in the lack of fish.
Table 4. There were no sculpin species or mountain whitefish observed in either Blackbird Creek or Big Deer Creek. This appears to be true for both the quantitative and qualitative samples. This is likely related to the elevated metal concentrations.

Page 8. Young of the year (YOY) Chinook salmon dominated in Blackbird Creek. This may be a result of fish seeking thermal refuge in Blackbird Creek from Panther Creek. It is impossible to determine if YOY salmon were seeking temperature refuge since temperature profiles for each system were not provided or temperature data were not collected. The size classification data collected in this study was not compared to other similar streams in the region, thus making the data inconclusive.

The data obtained from the scale samples are never presented in the document. The QA methods were not provided. Observations of variability in the aging method were not provided.

Paragraphs 1 and 8 both refer to comparisons to reference reaches. These reference reaches were never clearly identified, thus these conclusions could not be verified.

Table 5. The fish condition vs. measures of habitat quality vs. measures of biomass are not consistent. For instance, locations within Big Deer Creek demonstrated some of the highest biomass measures, yet yielded low Fish Condition factors (1.01). It is not clear if this is due to the age class distribution or some other factor.

Page 9. Paragraph 1. The conclusions were impossible to verify as the data used to derive the conclusions were not adequately presented.

Page 9. Subsection 3.8. This entire subsection calls out very critical habitat features which prohibit fish occurrence. Lack of integration of these observations into the conclusions for each tributary and apparently conflicting information precludes a comprehensive understanding of the controlling factors affecting the ecology of each system. For instance, page 11 indicates that Big Deer Creek upstream of South Fork Big Deer, generally has excellent rainbow trout/steelhead production conditions; however page 9 indicates that past river mile 0.7, this tributary is blocked by waterfalls.

Page 9. The sizes and numbers of each fish species that were examined for diets needs to be documented. Small chinook fry compared with 10-inch rainbow could account for the results of the apparent dietary differences. In addition, the diet of different species of fish may vary even for fish of similar size. It is unclear if enough fish were sampled to have any confidence in the results because no statistics are provided. Furthermore, the fact that these are electrofishing mortalities introduces a bias to the sampling effort and raises a question of whether the samples were random - it is possible that stressed fish succumbed to electroshocking stress in which case the diet may not be reflective of that of healthy fish.

Page 10. Paragraph 1. Statements regarding increasing trends as they relate to Idaho Fish and Game data are inaccurate and misleading. Although there is an apparent increase in the IDFG dataset, the densities still remain extremely low.

Page 10. Paragraph 2. It is inappropriate to compare four-pass electrofishing to snorkeling. Each technique has demonstrated biases. Numbers, sizes and species observed can vary widely with each technique depending on experience, equipment limitations, and the site sampled. In snorkeling sampling efforts, <70 mm fish are not eliminated from the data sets by IDFG, whereas they are in electrofishing sampling.

Page 11. These rankings were intended as a relative measure and were initially established by the Northwest Power Planning Council (NWPPC). These rankings may not apply to Panther Creek. It was inappropriate to use this ranking system without discussion and research in order to determine its applicability to the Panther Creek watershed.

Page 12. Upstream limitations are not cause for lack of fish in Big Deer Creek below South Fork of Big Deer since fish could easily wash down and are more abundant upstream.

Page 12. Although Blackbird Creek did have rearing fish present, the data are inadequate to determine that the habitat is supporting all life stages of salmonids, or is capable of supporting fish throughout their life cycle. It is unknown if the results are repeatable over multiple years, particularly in the absence of stocking. The fresh water flush from the clean water reservoir and summertime rains recorded in July/August could make water quality conditions temporarily suitable for rearing.

Pages 12 and 13. The conclusions from one objective were not linked to other applicable objectives. For instance, the last paragraph under Objective 1 indicates that fish were not found in South Fork Big Deer..., while under Objective 2 the habitat conditions within South Fork Big Deer appear to be the controlling factor. The conclusions are stated as fact, when in reality there are so many issues associated with each tributary that these conclusions are unfounded on the basis of the limited sampling effort performed.

Pages 12 and 13. Data trends observed by tributary were not addressed. For instance, there is a tremendous surge in biomass bracketed by PAF locations 19.2 and 19.5 which occurs above and below Deep Creek. This indicates that Deep Creek is perhaps affecting habitat quality.

Page 13. The applicability of the habitat quality criteria conclusions is seriously in question as the application of the criteria was out of context because it was established for steelhead streams that do not have significant numbers of resident rainbows. Without additional research and discussion, these conclusions are invalid.

Page 13. The 'Additional Conclusions' do not appear to be supported by any data provided within this report, and the data are lacking by which to verify them.

Appendix 1

This appendix differs from the Habitat Survey methods described in the document. It appears that two separate types of habitat measures were completed. The raw data for the instream cover, bottom substrate and habitat composition (described on page 4) were not provided. The methods for this Appendix were not described within the text of the report. It is also not clear as to how the results from this Appendix were incorporated into the conclusions of the report.

Table A1. A column which describes possible controlling factors affecting the presence and distribution of the habitat types was not included. It appears from the text that certain tributaries are valley confined, and contain falls features that affect the habitat distribution.

Appendix 3.

Definitions and example calculations for each variable (biomass vs. biomass catch) were not provided. A review of the data presented in the tables of this appendix was completed using the raw data presented, as part of the document review by EPA. However, the calculations of the biomass catch in some cases could not be verified. Data gaps were identified; for example, the SD for bull trout is missing on the calculated biomass results for BBF0.1 and the Biomass for 'all fish' for PAF24.0. There is no description of how values of Total Biomass, and Biomass were "estimated by proportion" for BBF 0.0. These limitations severely limit the usefulness of this appendix, and cast the conclusions into further question.

There are numerous sources of uncertainty associated with the calculations for certain locations that may have posed problems during electroshocking events. For instance, locations BDF0.0 and PAF 24.0 did not demonstrate a very steep rate of diminishing return for each sweep. If this was due to access, the presence of multiple barriers, or other factors, it was not discussed. The reasons for four sweeps completed for PAF10.4 was not provided.

Response to Exhibit G of BMSG's Comments

Introduction

Exhibit G of the BMSG's comments presents a summary of the BMSG's position regarding the cobalt water quality cleanup level that has been established by EPA at 0.038 mg/L. The BMSG's position has been primarily provided by S.R. Hansen and Associates, a consultant to the BMSG. The cobalt water quality cleanup level has been the subject of correspondence and meetings among the EPA, BMSG, State of Idaho, and natural resource Trustees. The most significant of these include:

- *Cobalt Toxicity Reference Value Position Paper*, prepared by CH2M HILL for the EPA on August 14, 2001. This position paper provided the rationale utilized by EPA in setting the cobalt water quality cleanup level.

- *Review of Cobalt Toxicity Reference Value Position Paper*, prepared for the BMSG by S.R. Hansen and Associates, March 19, 2002. This review presented the BMSG's initial position regarding EPA's water quality cleanup level.

- A meeting among the EPA, BMSG, State of Idaho, and natural resource Trustees, held in Boise, Idaho on March 27, 2002. EPA's cobalt water quality cleanup level and the BMSG's position regarding the cleanup level were discussed at this meeting. Also at this meeting, Dr. Carolyn Fordham of CH2M HILL presented EPA's response to the BMSG's position provided in the BMSG's March 19, 2002 review of the *Cobalt Toxicity Reference Value Position Paper.*

- The Microsoft Powerpoint™ presentation used to summarize EPA's response at the March 27, 2002 meeting was provided to the BMSG. The BMSG made minor revisions to their review of EPA's *Cobalt Toxicity Reference Value Position Paper*, apparently based on information provided in EPA's Microsoft Powerpoint™ presentation. This revised review, dated September 11, 2002, is provided in Exhibit G.

- EPA prepared a summary of its position on the cobalt water quality cleanup level and a response to the BMSG position first iterated in the March 19, 2002 review. This is included in Attachment 1 to these responses to Exhibit G comments. Attachment 1 is a summary of the Microsoft Powerpoint™ presentation used by EPA at the March 27, 2002 meeting and includes an explanation of how the cobalt water quality cleanup level was established and a point by point response to the BMSG's March 19, 2002 review.

The specific responses included below focus on the information in Exhibit G that was not presented in the original March 19, 2002 BMSG review. This portion of Exhibit G provides additional technical comments by the BMSG on EPA's position concerning the cobalt water quality cleanup level as presented by EPA in the March 27, 2002 meeting. These additional technical comments are titled "Response to Ms. Fordham's Comments" and begin on page 9 of Exhibit G. EPA considers these to actually be additional comments (rather than responses) by the BMSG and has treated them as such in the specific comments and responses below. There was a non-technical comment that was also provided in Exhibit G addressing peer review (see the comment beginning on page 7 of Exhibit G). This comment is essentially the same comment as the BMSG's comment 31 from Volume 1 and is addressed in EPA's response to comment 31.

Specific Responses

Comment 1. *Page 9, Issue 1. EPA used values from several studies by which to derive the cobalt PRG. Among these were two papers by Birge et al. (1978 and 1980). The BMSG has* *repeatedly commented that the Birge et al. values should be rejected from consideration as part of the cobalt TRV.*

Response 1. The BMSG's primary concern in this comment is that the raw data are not presented in Birge's published paper. Often raw data are not presented in published papers in peer-reviewed journals. The lack of these data do not make the resulting endpoints incorrect. The prevailing lack of cobalt toxicity information argues against rejection of this paper. Dr. Birge has apparently offered the BMSG evidence that the two endpoints are based on the same underlying data. Even if the 1980 and 1978 papers evaluate the same data sets and come up with slightly different toxicity endpoints due to different statistical methodology, the more recent of these studies (i.e., the 1980 document) should be retained. The fact that these data were mentioned but not used in the existing water quality criteria for another metal is irrelevant to the cobalt TRV, which is not a national water quality criterion.

Comment 2. *Page 10, Issue 2. This issue involves the Acute Chronic Ratio (ACR) derived by EPA from the BMSG Hydroqual (1996) data. This value was obtained by dividing the average of the acute LC50 values by the chronic NOEC value (0.213 mg/L). The BMSG maintains that the ACR developed from their own data for salmonids exposed in Panther Creek water is too high, and that it would be more appropriate to use an ACR developed from data for fathead minnows. EPA notes that a high ACR will provide a more conservative (i.e., lower) cobalt remedial goal.*

Response 2. EPA used the BMSG study (Hydroqual, 1996) in developing the cobalt PRG. This study exposed rainbow trout for a period of 60 days to cobalt in water collected from Panther Creek. There were also acute toxicity tests run concurrent with the subchronic 60 day test; however, these were run with different strains of rainbow trout, among them a strain resistant to the toxic effects of cobalt. The BMSG disagrees with EPA's interpretation of the Hydroqual 1996 toxicity test and maintains that the acute to chronic ratio (ACR) of 11.5 is too high. The BMSG position is that the chronic value is artificially low as no effects were observed at the maximum test concentration of 0.213 mg/L. This does not mean that effects would not have been observed at test concentrations just slightly higher. The BMSG should have rerun the toxicity test to obtain better endpoints, since their results were inconclusive. Therefore, it is possible that the BMSG study should not be used to develop the cobalt TRV for salmonids. Unfortunately, this would reduce the only site specific data to the 14-day NOEC obtained by RCG/Hagler Bailly of 0.124 mg per liter. Even if only this study was used, in order to adjust for interspecific variability in the absence of data for various species, this short-term subchronic NOEC would need to be divided by an appropriate uncertainty factor.

The BMSG's comments continue with a discussion of the Diamond *et al.* (1992) ACR. It is true that the Diamond *et al.* paper presents an ACR of 7.6 as an average value for fathead minnows and *D. magna*. BMSG then derived an ACR for cobalt in soft water using a geometric mean of the 50 mg/L water hardness values of 1.01 and >46.9, stating that this was based on data generated by Diamond *et al.* However, based on the BMSG's own definition of an ACR (i.e., 96 hr LC50/chronic value), BMSG's ACR derivation was incorrect. The ACR of 1.01 cited from Diamond *et al.* (1992) was derived using a 48-hour NOEC, not a 96-hour LC50, according to a footnote in the paper. This leaves only an ACR exceeding 46.9 for soft water from the Diamond *et al.* study.

The BMSG continues with a discussion of the ACRs for copper, arsenic, zinc, lead, nickel, and silver, apparently to refute EPA's general statement that ACRs can fall around the value of 10. EPA's general statement was intended to be just that, and the values presented by the BMSG do not appear to refute this statement. The ACRs presented by BMSG range from 2.2 to 51.3, suggesting that ACRs for metals vary widely. This is to be expected since the modes of toxic action of these different metals are also expected to be different. Given how widely the ACRs shown by BMSG vary for metals, the data suggest that it would be more appropriate to have a higher ACR for cobalt (for which the mechanism of toxicity is uncertain) rather than a lower ACR of 7.6 given the general lack of toxicity information available for aquatic life. The Diamond *et al.* data were not used by EPA to derive the cobalt TRV because these data were not specific to salmonids.

The 28-day LC50 was divided by the ACR because, for a significant part of the test, the organisms were exposed in a life stage that the BMSG has maintained is insensitive (i.e., the egg stage). Because the EPA concurs with the BMSG on the sensitivity of salmonid eggs, it is appropriate to consider only the post-hatching portion of the test as actual exposure. The Birge *et al.* study states that embryos were exposed from fertilization to one day post-hatching. Therefore, it is appropriate to divide this 28-day LC50 by an ACR.

Comment 3. *Page 11, Issue 3. The BMSG position is that application of an uncertainty factor of 6 derived from the BMSG Hydroqual (1996) data for salmonids exposed in Panther Creek water is not appropriate. This uncertainty factor was obtained by comparing the response of a sensitive strain of trout to the response of a resistant strain of trout. This indicates that there is uncertainty in the toxicity data within one species of salmonid.*

Response 3. The BMSG's position on this issue is not relevant to setting of the cobalt cleanup level. The data are inadequate by which to derive a national water quality criteria guideline, and EPA has acknowledged this point. The intraspecific differences in sensitivity are apparent from the toxicity tests performed by the BMSG. There are insufficient data to fully incorporate these intraspecific differences without use of an uncertainty factor. Application of an uncertainty factor of 6 derived from the site specific data is appropriate.

Comment 4. *Page 12, Issue 4. The BMSG objects to the application of the ACR to a toxicity endpoint besides the 96-h LC50, and requests that an additional comparison be considered of the RCG 96-h LC50 of 1.427 mg/L divided by the BMSG ACR of 11.5, resulting in a NOEC of 0.124 mg/L.*

Response 4. The BMSG's position on this issue appears to be in direct conflict with the BMSG's earlier issues regarding the ACR of 11.5 being too high. Application of the ACR of

11.5 to the 96-hour LC50 results in a NOEC nearly identical to the 14-day NOEC measured in the study. EPA's response to each of the points made by the BMSG is as follows:

- Number 1. The Birge *et al.* 28-day LC50 can be acceptably divided by the ACR since the bulk of the test was conducted on an insensitive life stage.

- Number 2. EPA will incorporate the 96-hour LC50 as requested by BMSG. EPA points out that this does not alter the median concentration, and that this effort by BMSG serves to strengthen confidence in the ACR of 11.5 derived from the BMSG Hydroqual (1996) study.

- Number 3. The Hydroqual LC50 data were directly used to obtain the ACR. Therefore, they should not be used in conjunction with the ACR to estimate the TRV.

Comment 5. *Page 13, Issue 5. The BMSG maintains that there is no cobalt-copper interaction indicated by the copper-cobalt interaction study performed by the Trustees consultant, RCG Hagler/Bailly and published as Marr, et al. (1998). The BMSG's position is that, because the data were not statistically significant, no copper-cobalt interaction effect exists.*

Response 5. The EPA maintains that the Marr *et al.* study indicates a potential interactive effect between cobalt and copper that is relevant to the Blackbird mine site. However, the Marr *et al.* cobalt copper interaction tests cannot be used to either refute or prove the presence of interaction of cobalt with copper toxicity. For this reason, this study was used in a weight of evidence manner, and not to develop the numerical cleanup level of 0.038 mg/L.

Trends are often used in scientific literature, particularly with biological data, for which variability may preclude statistical significance, yet where trends are obvious. EPA has previously stated that trends should be considered, but that they do not constitute proof. The Marr *et al.* paper only suggested that at cobalt concentrations above 50 ug/L (0.05 mg/L), the toxicity of copper increases.

Comment 6. *Page 14, Issue 6. The BMSG questions the controls used in the Marr et al. study, and maintains that EPA failed to address this concern previously raised by the BMSG.*

Response 6. EPA's presentation, as included in Exhibit G, is missing extensive verbal input that was provided by Dr. Douglas Beltman (one of the co-authors of the Marr *et al.* paper) during the March 27, 2002 meeting. Therefore, it is misleading for the BMSG to state that EPA failed to address the essence of Issue No. 6. Substantial input and discussion on this issue was made by Dr. Beltman regarding the paper. The end result of these discussions was that the data were sound, the conclusions are adequate, and that animal sensitivity is unlikely to have explained the differences.

Comment 7. *Page 16, Issue 7. The BMSG further questions the controls used in the Marr et al. (1998) study, which EPA points out was not used numerically in the TRV position paper.*

Response 7. The Marr *et al.* study was used by EPA only as an additional line of evidence. This is acceptable under the water quality criteria guidelines which state that questionable data "may be used to provide auxiliary information, but should not be used in the derivation of criteria". The TRV position paper indicated that this study was used only as an additional line of evidence; EPA included this information in the event that future studies could be performed to further elucidate the interactive nature between cobalt and copper, and to maintain an awareness of the potential for mixture toxicity.

Comment 8. Page 17, Issue 8. The BMSG indicates that none of the invertebrate toxicity studies are adequate by which to establish a cleanup level for salmonid food items. The BMSG continues to maintain that daphnid data should be totally rejected from consideration in development of an invertebrate TRV.

Response 8. EPA has acknowledged that Daphnia are not likely to be present in the Panther Creek watershed because it is a lotic ecosystem. EPA has also stated that, due to lack of invertebrate data, Daphnia are representative of invertebrates, and Daphnia are commonly used toxicity test organisms which form the basis of many water quality criteria. Therefore, the inclusion of daphnia data is appropriate. EPA maintains that the Tier II value of 0.023 mg/L is appropriate as the TRV for invertebrates, unless additional data are collected that would demonstrate otherwise. EPA has addressed the strengths and weaknesses in each of the cobalt toxicity papers, including the data derived by the BMSG, and has treated each of the studies fairly.

Comment 9. Page 17, Issue 9. The BMSG maintains that the Tier II value is totally driven by the daphnid data, while EPA has stated that it is weighted, but not totally driven.

Response 9. This appears to be an issue of semantics. See response to Comment 8 above as to why daphnid data are pertinent to the derivation of an invertebrate TRV.

Comment 10. Page 19, Issue 10. The BMSG objects to all of the invertebrate toxicity studies available and used by EPA in the cobalt TRV position paper, among them a study by Sodergren. The BMSG suggests EPA consider an additional study by Warnick and Bell.

Response 10. Sodergren was not used in the numerical computation of the TRV because of consideration of the methodology problems that the BMSG brought up in comments; however, Sodergren was maintained as an additional line of the evidence.

Although the data presented in the Warnick and Bell paper suggest that there was 50 percent survival at seven to eight days at 32 mg/L cobalt for two invertebrate species tested, the discussion in the paper clearly states the metal concentrations in test solutions decreased considerably over the duration of this study. This indicates that adsorption, precipitation, or some other physical-chemical change was occurring, and the authors stated that metal concentrations were only considered to be stable for 48 to 96 hours. Therefore, even the 96-hour test value is in question. The authors go on to state that the TLm (the concentration at which half the population survived) values are given in terms of initial concentrations, thus not reflecting the above mentioned decrease.

EPA did not use the Warnick and Bell study because the values in the study appeared to be excessively high relative to other information. EPA has compared the acute toxicity values reported in this study to the acute and chronic water quality criteria. For three different metals, the 96-hour TLm is well over a thousand times higher (range 1,400 to 1,694) than the chronic ambient water quality criteria (i.e., the CCC). This implies that half the test population dies at a concentration about 1,500 times that of the CCC. While this comparison is not conclusive because only three metals were compared, it suggests that any criterion that utilizes this study must be substantially lower than any of the TLm values reported by Warnick and Bell. If cobalt followed a similar pattern to cadmium, copper, and mercury, the cobalt water quality criterion would be a value of 16.0 mg/L (the TLm for *Ephemerella*) divided by an uncertainty factor of 1500, which would make the resulting endpoint approximately 0.010 mg/L, lower than the existing cobalt cleanup level.

Comment 11. *Page 19, Issue 11. The BMSG states that the Diamond et al. (1992) paper cannot be used due to effects on control organisms. BMSG indicates the Lind value cannot be verified as the reference is missing. BMSG maintains that the study cannot be used for the invertebrate TRV since Daphnia do not occur in the Panther Creek ecosystem.*

Response 11. The BMSG's position on this issue is not relevant because the Diamond *et al.* paper was not used by EPA in setting the cobalt cleanup level. It was only used in the Tier II invertebrate TRV describing potential ecological risks in the Aquatic Ecological Risk Assessment.

For further discussion on the Daphnia issues, see EPA responses to Comment 8 above.

Comment 12. *Page 20, Issue 12. The BMSG states that the site specific data indicate a PRG for cobalt for salmonids of 0.125 to 0.213 mg/L, and that a TRV for invertebrates cannot be established. The BMSG maintains that site specific data are the only ones that should be considered, and that the Tier II value is overly conservative.*

Response 12. EPA disagrees with the BMSG on the appropriate value for the cobalt cleanup level. See responses to the above comments regarding the limitations of the site-specific salmonid data and their use without application of an uncertainty factor for taxonomic variability, and the above responses regarding the invertebrate TRV, which is not considered numerically in establishing a cleanup level for cobalt.

Comments from Residents

Comment: *One commentor was disappointed the public meeting was cancelled and wanted to know the nature of the security concerns leading to the cancellation of the meeting.*

EPA Response: The public meeting was canceled due to threatened disruptions of the meeting and possible harm to participants. There were no particular concerns about the Panther Creek Inn area. In lieu of the meeting, EPA staff was available to talk one-on-one with any concerned citizens.

Comment: *One commentor wanted to know if the proposed cleanup plan would make the water in Big Deer Creek suitable for human consumption.*

EPA Response: Based on the human health risk assessment, arsenic in Big Deer Creek does not pose a potential risk for human consumption under recreational use. In addition, arsenic in Big Deer Creek does not exceed the State water quality standard for humans nor the federal drinking water standard of 10 ug/L for public water supplies.

Comment: *One commentor wanted to know if beaches along the Salmon River below the mouth of Panther Creek were contaminated and pose a potential risk to humans.*

EPA Response: There has not been extensive investigation of the beaches (i.e., overbank areas) along the Salmon River downstream from Panther Creek. The primary reason is that the concentrations of arsenic in overbank sediments along Panther Creek decrease significantly with the distance downstream from Blackbird Creek. The primary source of the arsenic in the overbank areas was mining activities along Blackbird and Meadow Creeks. The arsenic was transported down Blackbird Creek and deposited at the overbank areas along Panther Creek during large flow events, primarily following the period of greatest mining activity in the 1950s and 1960s. The nature of these large flow events is that the sediments become significantly diluted as they are transported downstream. For example, the arsenic concentrations in the overbank areas near the old Cobalt townsite, located about two to three miles downstream from Blackbird Creek (about 22 to 23 miles upstream from the Salmon River) averaged from about 1500 to 2100 parts per million (ppm) arsenic prior to cleanup in 2001. As the sediments were transported downstream, they became diluted. The furthest downstream recreational area that was demonstrated to have an unacceptable arsenic risk was the Napias Creek area, about 19 miles upstream from the Salmon River. The arsenic in the overbank areas near Napias Creek averaged about 825 ppm prior to cleanup. Further dilution occurred downstream from the Napias Creek area. In the lowest 5 miles of Panther Creek (0 to 5 miles upstream from the Salmon River), the arsenic in overbank areas averaged from about 50 to 279 ppm (13 overbank areas were sampled in this reach), which does not represent a risk under any of the recreational scenarios.

Any sediments transported from Panther Creek into the Salmon River would likely have been further diluted by the sediments in the Salmon River before they would have been deposited in overbank areas along the Salmon River. It is therefore extremely unlikely that any arsenic in overbank areas along the Salmon River would even approach the arsenic cleanup level for recreational areas (280 ppm for camping areas and 590 ppm for day-use areas). Thus, EPA determined that a sampling program for the overbank areas along the Salmon River was not necessary. Regardless, a reconnaissance of overbank areas along the Salmon River downstream from Panther Creek was conducted by the Idaho Department of Environmental Quality in 2000. A sample was collected in the only overbank area where it appeared that arsenic concentrations might be elevated. The arsenic concentration in this sample was less than 100 mg/kg, the detection limit of the analytical instrument (field portable x-ray fluorescence spectrometer).

Comment: *One commentor urged recovery and restoration of Panther, Meadow, Blackbird, Bucktail and Big Deer Creeks to enhance the habitat of the salmon and bull trout.*

EPA Response: The objective of the cleanup at the Blackbird Mine is to restore water quality and other aquatic life to levels capable of supporting anadromous and resident fish in Panther Creek (which include salmon and bull trout), South Fork of Big Deer and Big Deer (which include resident fish and bull trout if present in upstream waters). The objectives of the cleanup for Bucktail and Blackbird Creeks are different than for the other creeks. This is because the State of Idaho performed a Use Attainability Analysis and removed aquatic life protection as a designated beneficial use for Bucktail and Blackbird Creeks. Meadow Creek is a tributary to Blackbird Creek. As a tributary to Blackbird Creek, the States' beneficial use for Blackbird Creek also applies to Meadow Creek. As a result there is not a State water quality standard for protection of aquatic life in Bucktail, Meadow and Blackbird Creeks. The objectives of the cleanup in Blackbird and Bucktail Creeks are to improve water and sediment quality such that cleanup levels are not exceeded downstream in Panther Creek and Big Deer Creek respectively. In addition, the remedial goal for Blackbird Creek is to support aquatic life at levels similar to that of nearby reference streams, although not necessarily to support salmonids (i.e., salmon or bull trout) or metals-sensitive macroinvertebrate taxa. Meadow Creek is above the Early Action cleanup facilities and restoring water quality is not a goal of the remedial action.

Comment: *One commentor was concerned that, as part of Alternative P-2, institutional controls would be placed on their property.*

EPA Response: Institutional controls are being considered at only the properties identified in the Proposed Plan, not at all the properties along Panther Creek. The properties identified in the Proposed Plan are [redacted] [redacted] and former [redacted] and properties that were cleaned up as part the Early Actions that have contaminants remaining at depth.

Comment: *A property owner along Panther Creek whose property is addressed in the Proposed Plan commented that they do not want a cleanup option that would devalue their property unless they were adequately compensated.*

EPA Response: The property owners concerns are considered in the selected remedy in the ROD. One of the criteria that must be met for not removing the contaminated material and invoking Institutional Controls is the property owners' acceptance.

<u>Comment from the Salmon-Challis National Forest</u>

Comment: *The Forest Service expressed an interest in implementing BT-5 in phases. This would enable field monitoring to confirm the need for the Bucktail Creek pipeline for the purpose of meeting Applicable, Relevant and Appropriate Requirements (ARARs) in the South Fork of Big Deer Creek and for meeting the Ambient Water Quality Criteria (AWQC) for copper at the compliance point in Big Deer Creek prior to the pipeline's construction. If field monitoring indicates that the diversion is needed, then treatment of the pipeline effluent and contaminated stream sediment should be evaluated and implemented, if feasible, to reduce the level of contaminants being discharged to Big Deer Creek.*

EPA Response: EPA does not believe that a phased approach for implementing Alternative BT-5 in the Bucktail Creek drainage is a viable option. This is because if the bypass pipeline were not constructed, the predicted post-remediation concentrations of both copper and cobalt would be significantly above the water quality cleanup levels established for South Fork Big Deer Creek. As shown in Table 7-11b in the Feasibility Study, without the bypass pipeline the post-remediation concentrations for copper in South Fork Big Deer Creek would average about 22 μg/L in the spring and 47 μg/L in the fall, which is significantly above the Idaho water quality standard for copper (the hardness-based copper standards are also shown in Table 7-11b). The post-remediation concentrations for cobalt would average about 49 μg/L in the spring and about 57 μg/L in the fall, also above the cobalt cleanup level of 38 μg/L.

The values shown in Table 7-11b were calculated assuming that the seep collection system in Bucktail Creek would be 65% effective at removal of the loads, which is probably conservative. However, even if a more optimistic removal effectiveness of 80% is assumed, the post-remediation concentrations of copper in South Fork Big Deer Creek would be considerably greater than the water quality standard if the bypass pipeline is not constructed. A calculation assuming 80% removal indicated that, while the cobalt cleanup level would be met, the copper concentrations in South Fork Big Deer Creek would average about 13 μg/L in the spring and about 27 μg/L in the fall. These values would be about 1.3 to 2.7 times the water quality standard. In addition, it is likely that metal releases from Bucktail Creek sediments will cause the copper ARAR and cobalt cleanup level to be exceeded in South Fork Big Deer Creek.

Given the water quality predictions above, the seep collection is not enough by itself to meet the copper ARAR in South Fork Big Deer Creek. In addition, metal releases from Bucktail Creek sediments will likely cause the copper ARAR and cobalt cleanup level to be exceeded in South Fork of Big Deer Creek. Therefore, implementation of the seep collection and then performance of monitoring to determine if the diversion is needed is not supported by the water quality predictions and is not justifiable. However, treatment of the pipeline effluent will be evaluated in the future as a contingency if monitoring indicates that the copper ARAR in Big Deer Creek is not met.

Comments from the State of Idaho

Comment: *The State commented that it does not appear that the pipeline or ditch diverting Bucktail Creek around the South Fork of Big Deer Creek, contemplated in BT-5, will further* *efforts to meet the water quality criteria or to sustain all life stages of salmonids in Big Deer or Panther Creek. A pipeline may be necessary in the future to provide a passive treatment system to meet water quality in Big Deer Creek and/or Panther Creek.*

Alternative BT-5, diverting Bucktail Creek into a ditch or pipeline around the South Fork of Big Deer Creek may have its own environmental costs and may involve a significant long-term maintenance burden while providing only limited environmental benefit. EPA may wish to reconsider the environmental costs vs. the environmental benefits of this element of Alternative BT-5.

EPA Response: The State is correct that the diversion of Bucktail Creek does not affect meeting cleanup levels in Big Deer Creek or Panther Creek. The purpose of the pipeline is to meet the copper and cobalt surface water cleanup levels in South Fork of Big Deer Creek which includes meeting the state water quality standard for copper which is an ARAR. The diversion is expected to be constructed primarily along the existing Bucktail Creek road, and the pipeline will be underground. Therefore, the diversion will have very little environmental costs or disruption. The long-term maintenance of a pipeline or ditch is minimal and straightforward and no more onerous than the maintenance that already exists on the significant amount of pipeline and ditches that were constructed as part of the Early Action. The environmental benefit of the diversion is large as it will allow South Fork of Big Deer Creek to meet the state copper water quality standard and cleanup level for cobalt.

Comment: *The State determined that the pipe or ditch diversion in Alternative BT-5 could be defined as a point source discharge under Idaho Water Quality Standards. Therefore, the substantive requirements of NPDES permits and mixing zone may also be appropriate for the Bucktail drainage. The State concluded that subject to monitoring requirements the proposed "mixing zone" in Big Deer Creek needs to be accepted by the Department.*

EPA Response: In the ROD, EPA has determined that NPDES permit requirements are relevant and appropriate for the diversion into Big Deer Creek. Acceptance of the mixing zone is subject to monitoring that will include the requirements of the State.

Comment: *The State provided rationale on why the applicable Idaho Water Quality Standard should be used as the cleanup level for copper rather than the Federal AWQC as relevant and appropriate.*

EPA Response: In the ROD, the EPA is using the Idaho Water Quality Standard for copper as the cleanup level in surface water.

<u>**Comments from Idaho Conservation League**</u>

Comment: *The Idaho Conservation League (ICL) encouraged EPA to utilize the AWQC to establish cleanup goals for copper and arsenic. The State of Idaho's water quality standards for these pollutants are unacceptable and do not adequately protect human and aquatic health.*

EPA Response: EPA has carefully reviewed the federal and state criteria for copper and arsenic in order to determine the appropriate cleanup levels for this Site. EPA has determined that the State of Idaho water quality criteria is the appropriate cleanup standard for copper. (See Response to BMSG Comment # 29) . EPA also performed a detailed review of the federal criteria for protection of human health related to arsenic in surface water. (See Response to BMSG Comment 28.) EPA has determined that the Federal AWQC for arsenic is relevant and appropriate for evaluating surface water quality for protection of human health at a 10^{-4} risk level based on "consumption of organisms only" in those creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big Deer Creek and Big Deer Creek). These determinations were based on the statutory factors set forth in Section 121(d)(2)(A) and (B) of CERCLA. Further information is available in Chapters 8 and 3 of the ROD.

Comment: *The ICL expressed concern that the EPA has chosen a "non-numerical narrative" cleanup goal for the area and should have a numeric goal. The ICL is concerned that the narrative goal will result in arguments on "how clean is good enough". It would be better to have a numerical goal so there is little doubt about what "clean" means.*

EPA Response: The narrative cleanup goals are only utilized in streams that are not protected for aquatic life. In such streams, EPA has established a narrative goal to ensure that steps are taken to improve the quality of these streams and to eliminate adverse downstream impacts.

Comment: *The ICL continued to object to the state of Idaho's removal of the aquatic life as a beneficial use and the curtailment of recreational contact as a beneficial use for the streams impacted by the Blackbird Mine.*

EPA Response: Blackbird Creek and Bucktail Creek are the only streams impacted by the Blackbird Mine where the aquatic life beneficial use has been removed. The state re-evaluates beneficial use designations every three years. At such time the State may revise the beneficial use designation. EPA's water program (not CERCLA) will review any future beneficial use changes.

Comment: *It is stated that the Institutional Controls would "preclude activities at the mine site that would interfere with the remedy." The ICL believes the proposed operation of the Idaho Cobalt Project would interfere with the remedy. EPA needs to make it clear that the future operation of the Idaho Cobalt Project is unacceptable until such time that the area's creeks are in complete compliance with all applicable water quality standards <u>and</u> it can be demonstrated that the Idaho Cobalt Project will not exacerbate water quality problems.*

EPA Response: Under CERCLA, EPA only has the authority to preclude activities at the mine that would interfere with remedy. The US Forest Service is performing an Environmental Impact Statement (EIS) for operation of the Idaho Cobalt Project pursuant to the National Environmental Policy Act (NEPA). The EIS will go out for public comment. EPA is participating in review and comment on NEPA documents.

Comment: The ICL expressed concern that a soil cap is not sufficient. Their two main concerns are: 1) it seems inappropriate to use the contaminated soils removed from overbank areas on Blackbird Creek as a cap, and 2) water will continue to percolate through a soil only cap. The need for and environmental benefit from an impermeable cap should be evaluated.

EPA Response: A clay cap for the West Fork Impoundment was evaluated in Appendix D of the Feasibility Study. This evaluation indicated that a clay cap may be somewhat more effective at reducing cobalt discharges from the West Fork Impoundment (approximately 55 percent reduction compared to approximately 41 percent reduction). However, there are considerable uncertainties in the modeling used in Appendix D to predict cobalt reductions, both in terms of magnitude of reductions and in the time to achieve the reductions. This is true regardless of whether a clay cap or a soil cover is utilized. Because of these uncertainties, EPA proposed Alternative BB-7 in the Proposed Plan which provides for much greater certainty of cobalt reductions in a timely manner through treatment of the discharges from the West Fork Impoundment. The considerably greater expense of a clay cap is not necessary with Alternative BB-7 because this alternative is predicted to meet the cobalt water quality goals, even if there are no cobalt reductions as a result of the cover. Any reductions of cobalt loadings as a result of the cover (if reductions do occur in the future) would only mean that less of the discharge from the impoundment would need to be intercepted and treated to meet downstream cobalt water quality goals.

It should be noted that the West Fork Impoundment is not a significant source of copper to Blackbird and Panther Creek, which is why the evaluations and loading predictions in Appendix D of the Feasibility Study focused on cobalt reductions. A clay cap would not result in significant reductions in copper loadings from the West Fork Impoundment compared to a soil cover.

Comment: The ICL expressed concern over reliance on natural recovery for instream sediments. They felt EPA should describe the mechanism at work is the redistribution and eventual dilution of pollutants. They are concerned that reliance of natural recovery will not provide the assurance that standards are met in any specific number of years. EPA should set minimum standards and expectations for this cleanup mechanism.

EPA Response: In the proposed plan, EPA describes that natural recovery of instream sediments includes a variety of natural, physical, chemical and biological processes that result in the concentration of contaminants in sediments being reduced over time without taking active measures (such as dredging) to achieve cleanup levels in sediments. For example, metals concentrations are reduced by physical sediment transport from scouring and mobilization of fine-grained sediments until concentrations in sediments are reduced to cleanup levels.

Meeting sediment cleanup levels in Panther, Big Deer and South Fork of Big Deer Creeks is not as time critical for improvement of aquatic habitat quality as is meeting the surface water cleanup levels. The reason is that most of the current measured sediment concentrations are below known probable toxic levels; thus, benthic communities should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve as water quality is restored. Numeric sediment cleanup levels are provided in the ROD for Panther, Big Deer and South Fork of Big Deer Creeks. However, the time to achieve sediment cleanup levels is not expected to affect the long-term effectiveness.

Comment: *Concerns with the preferred alternative BB-7; ICL does not believe the NPDES permit should allow the use of a mixing zone.*

EPA Response: An NPDES permit is not required for a cleanup being performed under CERCLA. However, the substantive requirements of NPDES should be followed. In accordance with the Clean Water Act and the State of Idaho Water Quality Standards, point source discharges may allow a mixing zone. Monitoring after implementation of the remedy will be required to ensure that the mixing zone does not interfere with beneficial uses in Panther Creek. Acceptance of the mixing zone is subject to monitoring that will include the requirements of the State.

Comment: *ICL is concerned that EPA has failed to adequately address the initial contamination of waters in the Bucktail Creek drainage and has instead focused primary (and apparently solely) on the treatment/dilution of polluted Bucktail Creek water. EPA needs to address how it will keep the pit and tailings areas from contaminating water in the first place.*

EPA Response: As part of the Early Action, EPA determined that the best option for addressing contaminants coming from the pit, workings and waste rock piles in the Bucktail Creek drainage was through collection and treatment of contaminated water. The remedial action is a continuation of the Early Action.

Comment: *ICL objected to the diversion of Bucktail Creek around the South Fork of Big Deer Creek and then discharging into Big Deer Creek where larger flow allows a mixing zone capable of diluting the concentration of the pollutant. Bucktail Creek is horribly polluted and needs to be cleaned up. In addition, EPA needs to develop an NPDES permit for the Bucktail Creek diversion.*

EPA Response: The diversion of Bucktail Creek allows for the same amount of metals loading into Big Deer Creek as the other alternatives which allow Bucktail Creek to flow into South Fork of Big Deer Creek which flows into Big Deer Creek. The State of Idaho removed the beneficial use designation for aquatic life and recreation from Bucktail Creek and, consequently, there is no water quality standard (i.e., ARAR) that must be met. As noted in the use attainability analysis performed by the State of Idaho to remove the beneficial use, Bucktail Creek is too small to have any real likelihood of contact recreation and the physical conditions of the creek, such as it's steep gradient and small size and flow, likely preclude it being used for fish. Therefore, EPA has determined that a narrative goal for Bucktail Creek is most appropriate. Two alternatives were considered in the Feasibility Study that included active treatment of the surface waters of Bucktail Creek at the mouth of Bucktail Creek. These were identified as Alternatives BT-7 and

BT-8. These alternatives were evaluated and screened out in Chapter 5 of the Feasibility Study because they would require a large dam or dams for storage, a large treatment plant to treat the surface waters, and extension of power lines, with corresponding short and long-term environmental impacts. In addition, these alternatives would be substantially more costly than Alternative BT-5 without providing significant improvement in water quality. If Alternative BT-5 cannot meet the water quality goals in Big Deer Creek consistently, EPA will evaluate contingent alternatives. One or more of these contingent alternatives would likely include treatment of the surface waters of Bucktail Creek, with treatment located at the downstream end of the diversion pipeline. In the ROD, EPA has determined that NPDES permit requirements are relevant and appropriate for the diversion of Bucktail Creek. Acceptance of the mixing zone is subject to monitoring that will include the requirements of the State.

Comment: *Sediment removal should be incorporated into preferred alternative BT-5. This alternative should be amended to include identification and removal of hot spots. This would allow EPA to minimize sediment load increases and maximize removal of pollutants. This approach is being applied in Blackbird drainage. EPA should do it in Bucktail drainage too.*

EPA Response: EPA believes that the seep collection should be implemented and then monitoring performed to evaluate the potential long-term effects of sediments to meeting surface water cleanup levels. Based on the monitoring, EPA may evaluate if additional actions on sediments are necessary to meet water quality cleanup levels in a reasonable timeframe. The evaluation of additional actions may include removal of hot spots, if warranted. Removal of overbank deposits, not in-stream sediments, is part of the remedy in Blackbird Creek drainage.

Comment: *ICL is concerned over the lack of specificity in the preferred alternative of a combination of alternatives P-2 and P-3. The ICL supports the joint use of both Institutional Controls and Sediment Removal in an effort to cleanup the Panther Creek area. However, EPA's discussion of which mechanism will be used and where is too vague to allow readers to understand the scope of the alternative and the expected efficacy of the plan. The development of numerical cleanup standards would aid EPA in decisions regarding where and when the application of P-2 and P-3 would be most appropriate for this area.*

EPA Response: The ICL has misinterpreted the proposed alternative for the Panther Creek drainage. The proposed alternative is to remove overbank deposits above the cleanup level at the [redacted] and former [redacted] properties. At some or all of the [redacted], and [redacted] (if necessary) properties, Institutional Controls may be utilized if acceptance of the property owner and a grantee can be achieved. EPA plans to allow instream sediments of Panther Creek to naturally recover (also see response to comment on natural recovery).

Comments received from the Nez Perce Tribe

EPA received comments from the Nez Perce Tribe on November 22, 2002. The public comment period ended on October 10, 2002. EPA has reviewed the comments provided by the Nez Perce Tribe. Many of the comments provided by the Nez Perce Tribe are similar to the comments provided by other commentors. Since the Nez Perce Tribe comments were received after the close of the public comment period and since most of the comments are addressed above in response to other commentors, EPA is not providing a detailed response to each of the comments. However, the comments have been placed in the administrative record.

TECHNICAL MEMORANDUM CH2MHILL

TO: Fran Allans/EPA

COPIES: Amy Lange/CH2M HILL/DEN
John Lincoln/CH2M HILL/BOI

FROM: Carolyn Fordham/CH2M HILL/DEN

DATE: October 23, 2002

SUBJECT: Summary of rationale for EPA's Cobalt Water Quality PRG and Responses to BMSG's comments concerning EPA's Cobalt Water Quality PRG

PROJECT: 152238.PR.04

Introduction

This technical memorandum provides a summary of the information and methodologies used by EPA in developing the Preliminary Remediation Goal (PRG) for cobalt in surface waters at the Blackbird Mine site. Included in this technical memorandum is a summary of information that was presented in a meeting among EPA, BMSG, State of Idaho, and natural resource Trustees at Boise, Idaho on March 27, 2002. Also included in this technical memorandum is a response to comments provided by the BMSG in a March 19, 2002 review of a previous document titled *Cobalt Toxicity Reference Value Position Paper*, prepared by CH2M HILL for the EPA, August 14, 2001.

Background

The Blackbird Mine site has both cobalt and copper contamination in surface water. Cobalt federal or state water quality criteria for the protection of freshwater aquatic life are unavailable, and a toxicity reference value had to be derived for the ecological risk assessment in order to estimate risks to salmonids and their prey items. A preliminary remedial goal (PRG) was derived from the available toxicity information in order to obtain potential cleanup levels, and to provide the Feasibility Study with a goal by which to assess remediation efforts.

Three threatened species of salmonids are of concern in the Panther Creek area. These are:

- Bull Trout
- Snake River Chinook Salmon
- Snake River Basin Steelhead Trout

In addition, other salmonids such as rainbow trout and other fish species inhabit streams in the area. This area provides recreational fishing opportunities as well as habitat for ecological receptors.

Very little data exist regarding the toxicity of cobalt to aquatic life. The available data suggest that cobalt is hardness dependent, with toxicity increasing as hardness decreases. The water in

Panther Creek is very soft (average approximately 45 mg/L), suggesting that cobalt could be more toxic than predicted in laboratory tests where harder water is used. Some data indicate cobalt is less toxic in short-term as opposed to longer-term exposures (i.e., Co has a delayed response).

Given the limited information regarding the toxicity of cobalt to aquatic life, the goal is to develop a cobalt criterion that is protective of special status salmonids and their food supply without being overly restrictive with respect to cleanup. The Aquatic Ecological Risk Assessment (AERA) developed a toxicity value specific to salmonid toxicity of 38 μg/L, and one specific for all aquatic life that could serve as a food supply for salmonids (i.e., forage fish, benthic invertebrates) of 23 μg/L. These values were considered as PRGs. The value ultimately selected as the cobalt PRG was the higher of the two values - 38 μg/L. The selection process is described in detail below.

Methods

To develop the PRG, EPA utilized the following process:

- Reviewed existing Federal guidance
- Reviewed existing criteria from other States or government agencies
- Searched the peer-reviewed literature, obtaining copies of primary sources whenever possible and
- Reviewed site specific toxicity studies and other supporting information

There is no existing Federal guidance for cobalt because there is no established water quality criterion. A national water quality advisory value of 15 μg/L is available. In addition, criteria estimated by EPA's Tier II approach have been calculated by the Oak Ridge National Laboratory. The Tier II values are statistical estimates expected to be *higher* than a national criterion no more than 20% of the time. The Tier II cobalt criterion estimated by this methodology is 23 μg/L. It includes data from *Daphnia sp.* (water fleas), fish, and amphibians. Daphnia are not stream-dwelling invertebrates, and they appear to be highly sensitive to cobalt. Therefore, there is the possibility that use of Daphnia data skews the cobalt criteria downward (i.e., makes it too conservative). Conversely, due to the general lack of cobalt toxicity data for invertebrates, and the presence in Panther Creek of invertebrate taxa known to be sensitive to other metals, it is protective to include the Daphnia data as surrogate values for invertebrate toxicity.

There are limited cobalt surface water criteria from nonfederal agencies. Several states and Canada have promulgated cobalt surface water criteria. The values are as follows:

- Minnesota 0.9 μg/L
- New York 5 μg/L
- Ontario 5 μg/L

These values are heavily weighted toward data from *Daphnia.*

There was some information available from published peer reviewed literature. Three studies were obtained that were not used in development of the ORNL Tier II criterion in 1996. These were:

- Sodergren (1976)
- Warnick and Bell (1969)
- Diamond et al. (1992)

Sodergren (1976) tested toxicity to mayflies in a 4-wk growth inhibition test. Cobalt produced mayfly mortality at 32.6 μg/L. Cobalt also affected the emergence of nymphs to adults and affected ability to fly at 5.2 μg/L. This paper has some questionable methods, which were raised by the BMSG and discussed at length in conference calls among the EPA, BMSG, State of Idaho and the natural resource Trustees. Because this paper was the only study on an invertebrate taxa similar to those found in the Panther Creek drainage, it was considered to be important data; the method limitations were not considered to be unacceptable to the point that the data were unusable, but they were considered more uncertain. This study was therefore used as an additional line of evidence.

Warnick and Bell (1969) obtained a 4-day LC50 of 16,000 μg/L for a mayfly. However, the authors state that in this study cobalt exposure concentrations decreased over the duration of the exposure period, thus increasing uncertainty in the resulting LC50. Animals were likely not exposed to the stated test concentrations indicated. It appears there was no replication for each test concentration. Because of its acute exposure period, lack of replication, and uncertain test concentrations, this study was discarded.

Diamond et al. (1992) studied *Ceriodaphnia* and fathead minnows and found cobalt toxicity inversely related to water hardness. A criterion of 44.2 μg/L was obtained from data for seven species. The lowest hardness in this study was 50 mg/L $CaCO_3$.

Other studies that were reviewed during development of the cobalt PRG include Birge et al. (1978, 1980); Kimball (1978), and the site-specific data. Birge et al. (1978, 1980) tested vertebrates in subchronic tests from egg fertilization to 4 days post-hatching and developed LC01 and LC50 endpoints. Rainbow trout were exposed for 28 days, goldfish for 7 days, and narrow-mouthed toads for 7 days. The study resulted in the following LC50 values:

- Trout 470 to 490 μg/L
- Goldfish 810 μg/L
- Toad 50 μg/L

Kimball (1978) obtained a 28-day NOEC for growth of 210 μg/L, and LOEC of 390 μg/L for fathead minnows.

Several site-specific studies have been performed with rainbow trout, a salmonid species. The longest of these was a 60 day chronic growth and development test conducted by HydroQual

Labs for the BMSG. This study resulted in a chronic NOEC of 213 µg/L, which was the highest concentration tested. Acute tests conducted concurrently with the chronic study showed a wide variation in LC50s (1,000 to >9,000 µg/L), variation that was ultimately traced to the strain of trout used in the tests. A resistant strain of trout was used in the chronic test; thus the NOEC is <u>not</u> protective of other, less resistant, strains. One concern of EPA's is that this level of variability between strains will also be reflected in an even wider range of variability between salmonid species; thus, uncertainty factors need to be applied to the NOEC derived from this study in order to estimate a NOEC appropriate for salmonids, particularly species of special status.

A subchronic test (14-day) was conducted with juvenile rainbow trout (RCG/Hagler Bailly, 1995). This test obtained a NOEC of only 125 µg/L, and a LOEC of 250 µg/L. Other tests conducted in conjunction with this effort indicated that 50 µg/L cobalt enhanced the toxicity of copper (published as Marr et al., 1998).

Methodology for Development of a Cobalt PRG for Panther Creek Salmonids

The cobalt PRG thus considered the following types of information:

- Studies for aquatic life other than salmonids (i.e., invertebrates, other fish taxa);
- The available federal, state, and other governmental criteria or guidelines; however, these are influenced by *Daphnia* values and are likely overly conservative;
- Published studies with invertebrates and fish, particularly studies with species likely to occur in Blackbird/Panther Creek drainages;
- Site specific data.

EPA selected salmonid-specific studies to obtain the PRG. The most appropriate values are chronic (i.e., long-term) studies, resulting in a mortality, morbidity, or reproductive "no effects" endpoint. A NOEC endpoint is likely to be protective of both populations and individuals in the field. The existing salmonid NOECs from site-specific data were short-term (14 days) or had methodology problems (i.e., used resistant strain of trout).

Thus, a value protective of threatened salmonids would have to be lower than the measured site-specific NOECs. The toxicity values used to develop the PRG are presented below:

Summary of Chronic Values for Salmonids				
Endpoint	Value (ug/L)	Source	UF	TRV (ug/L)
LC01	38	Birge et al., 1980	None	38
LC01	34	Birge et al., 1978	None	34
28-d LC50	470	Birge et al., 1978	ACR	41
28-d LC50	490	Birge et al., 1980	ACR	43
60-d NOEC	213	HydroQual, 1996	6	36
14-d NOEC	125	RCG Hagler Bailly (1995)	6	21
96-h LC20	533	RCG Hagler Bailly (1995)	ACR	46
Median				**38**

EPA applied an Acute-Chronic Ratio (ACR) of 11.5 developed from the chronic site-specific study to nearly all lethal salmonid values, with the exception of the LC01, which was considered to be low enough on the dose-response curve that lethality would be unlikely. There were 11 acute tests conducted during the chronic site-specific study, in which the LC50s varied by a factor of 9 (1,000 to 9,000 ug/L). The average LC50 was 2,440 ug/L. The ACR was estimated as the average Acute LC50/60 day NOEC [2,440/213 = 11.5].

EPA also applied an intra-specific uncertainty factor (UF) of 6 to the 60-day growth NOEC of 213 mg/L due to the observed variability in cobalt tolerance between strains of trout. To obtain this intra-specific uncertainty factor, EPA averaged LC50's for the Campbell River strain, and averaged LC50's for the sensitive strains. The LC50 averages differed by a factor of 6. EPA applied this UF to the subchronic site-specific14-day NOEC to reflect taxonomic uncertainty, since the14-day NOEC study did not incorporate multiple strains of fish which would have provided information regarding intra-specific variability in sensitivity to cobalt. One additional consideration in development of the PRG was to recommend a PRG below 50 mg/L cobalt in order to avoid significantly increasing copper toxicity.

Discussion

EPA's goal is to determine a cobalt water quality cleanup level protective of the environment and special-status salmonids protected under the Endangered Species Act. The BMSG has provided comments concerning the sources and methodology used by EPA in developing the cobalt cleanup level, and offered alternative approaches to dealing with the uncertainties surrounding cobalt toxicity. EPA has acknowledged the uncertainties associated with the cobalt aquatic life toxicity data; however EPA believes that these data are adequate by which to make risk management decisions.

The BMSG provided specific comments in their March 19, 2002 review of the *Cobalt Toxicity Reference Value Position Paper*, prepared by CH2M HILL for the EPA, August 14, 2001. Included below are summaries of the BMSG comments followed by specific responses.

***Comment 1.** Use of the Birge LC01 is not appropriate because the underlying data are lacking; LC01 data are not robust.*

Response 1: Dr. Birge was contacted on March 21, 2002 and can provide a memo with additional information regarding the LC01. Dr. Birge maintains the LC01 is a good representation of a chronic NOEC. The LC01 has been used by other authors to represent chronic NOECs. The LC01 values were used as a component of the PRG value as estimates of chronic NOEC concentrations as an additional line of evidence in light of the limited data available.

Comment 2.

a. The ACR of 11.5 is too high since the chronic value from the BMSG study is artificially low (i.e., no effects were observed at the highest concentration tested).

b. The BMSG indicate that Diamond has an ACR of 7.6, which shows the EPA ACR of 11.5 is too high.

c. Additionally, the ACR should not be applied to a 28-day LC50, only to a 96-hour LC50.

Response 2:

a. ACRs are often used to estimate chronic toxicity values from acute toxicity data; a high ACR lowers the PRG (Acute LC50/ACR=PRG). When the ACR is calculated for each acute test (i.e., the acute value/chronic NOEC instead of the average acute value/chronic NOEC, as done for the cobalt PRG), ACRs from the BMSG data range from 4.7 to 42, reflecting nearly an order of magnitude uncertainty due to using different strains of a single species. Uncertainty in extrapolating from limited data to other salmonid species is at least this high. The Trustees have suggested EPA actually underestimated the "true" ACR. The Trustees maintain that the acute data from the resistant trout strains (>4,000 ug/L) should have been compared to the chronic value of >213 ug/L for an ACR of >18.8, and that acute data for the sensitive strains should not have been used.

b. Diamond states that their ACRs were underestimated; the 7.6 value is obtained as a geometric mean by mixing results from different studies, which is not a preferred approach (ORNL, 1996). An ACR strictly from Diamonds' data is at least 16. Other sources indicate that ACRs are often around 10 (Rand and Petrocelli, Aquatic Toxicology), and that often chronic toxicity curves fall an order of magnitude below the acute curves. Thus, use of 11.5 is not overly conservative, but reasonable.

c. For 24 days of the 28-day LC50, the test was done on eggs which the BMSG has maintained are not sensitive to metal toxicity. Thus, the 28-day test was not a "chronic" test. Thus, applying the ACR is reasonable. The goal is to develop a criterion protective of threatened salmonid species; criterion should therefore be well below lethal levels. A protective criterion would be well below the 14-day NOEC of 125 ug/L, as toxicity can increase with exposure time. Dividing the available site specific 96-hour LC50s by the average ACR as suggested by the BMSG yields the following estimated Chronic Values:

. 1,427/11.5=120 ug/L 2,440/11.5 = 210 ug/L

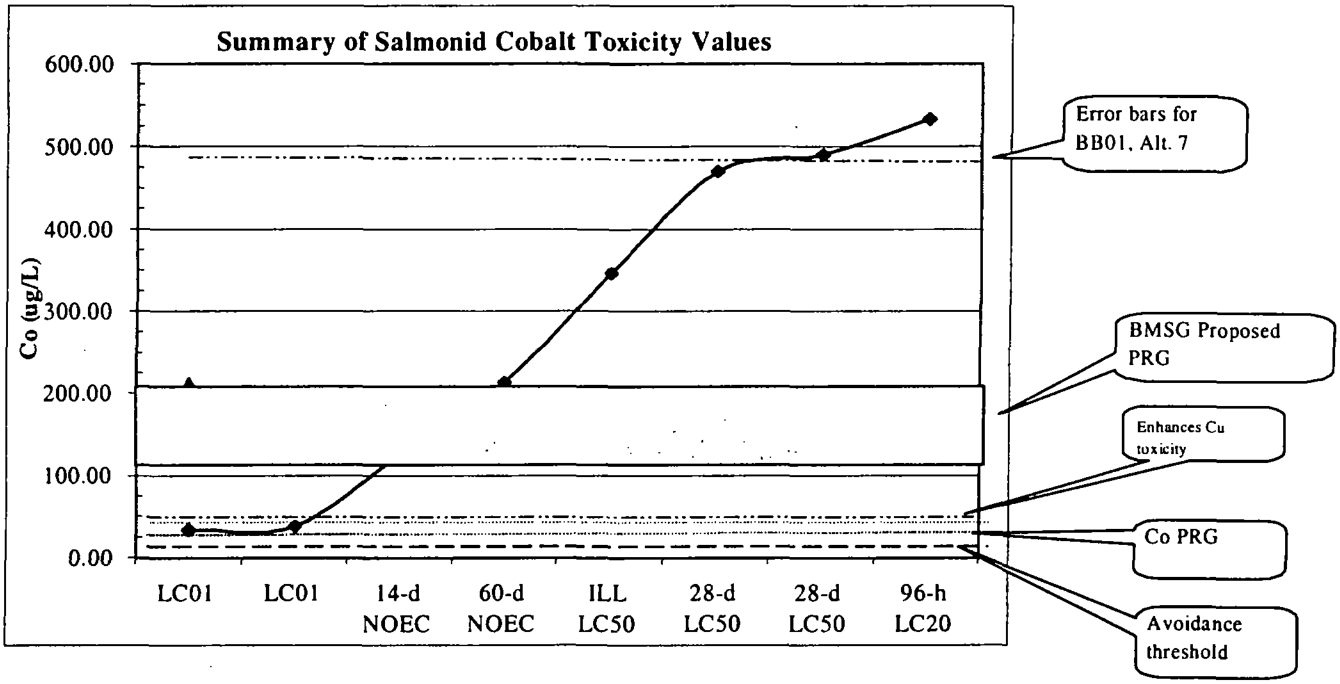
These do fall within the range of the measured NOECs; thus supporting the ACR of 11.5.

Comment 3. *The measured NOECs should not be divided by an uncertainty factor of 6 because the "actual range" of sensitivity is known.*

Response 3: The actual range of sensitivity is unknown. Two strains of trout were inadvertently used in the BMSG test, which indicates that there could be an even wider range of natural variability in wild salmonids. Only the resistant strain was tested in the BMSG chronic test. An uncertainty factor of 6 based on site-specific data is not arbitrary when evidence indicates a difference in sensitivity. Taxonomic uncertainty is addressed in national criteria development by the wide array of data incorporated into the criterion; our situation differs because the available data for cobalt are more limited. Thus, an uncertainty factor for taxonomic uncertainty is appropriate.

Comment 4. *The ACR should not be applied to the 96-hour LC20 because this underestimates the NOEC. The RCG 96-hour LC50 of 1,427 ug/L should be divided by the BMSG ACR of 11.5, which results in a NOEC of 125 ug/L (the measured NOEC was 124 ug/L).*

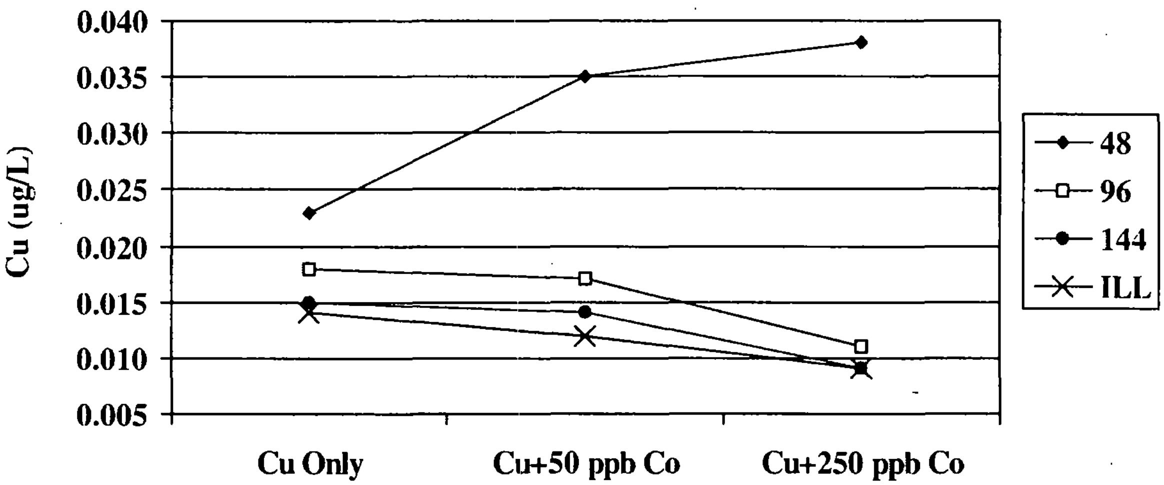
Response 4: Note that the RCG NOEC of 125 ug/L is for a 14 day exposure. Toxicity tends to increase as exposure time increases. Thus, a value below that of 125 ug/L is a better estimate of a protective criterion for chronic exposure. The following figure graphically depicts the values under discussion.



The points on the graph are the values from the various studies considered as input to the cobalt PRG. The BMSG proposed PRG range (solid box area) is bounded by the BMSG measured chronic NOEC of 213 ug/L and the RCG/Hagler Bailly measured subacute NOEC of 125 ug/L. Neither of these values acknowledge nor incorporate the observed variability that different strains of rainbow trout exhibited with regards to cobalt toxicity. The degree of sensitivity and the amount of variability of other species of salmonids is unknown with respect to cobalt toxicity. Thus, the cobalt PRG used at the Blackbird Mine Site must be lower than the BMSG proposed PRG in order to be protective of threatened and endangered salmonids. Application of the site-specific ACR of 11.5 to the literature based acute values, and applying the uncertainty factor of 6 to account for intra- and interspecific variability to the site-specific subacute and chronic values, is the most reasonable method for estimating a site-specific PRG.

Comment 5. *There were no statistically significant differences in the copper-cobalt interatction study; therefore the observations are due to chance.*

Response 5: It is true that the Marr et al. study did not exhibit statistically different responses. However, a clear trend exists which argues against random chance, and if the study had been repeated with additional animals, statistical significance could have been attained. See the following figure, which depicts the effects of three cobalt concentrations on the LC50 for copper at four different exposure times (i.e., 48, 96, and 144 h, and incipient or time independent), for clarification.



Comment 6. The Copper-Cobalt Interaction experiments were performed 3 weeks apart with different cohorts and animal sensitivity could have explained the differences in the effect on the LC50s.

Response 6: Intralab variability can explain up to 10-15% of toxicity test results (Rand and Petrocelli, Aquatic Toxicoloty, 1996). The ILL LC50 for Cu only and Cu/50 Co is only ~15% different and is within the realm of uncertainty and natural variability. The ILL LC50 for Cu/250 Co is 36% lower, thus making the dose-response pattern clear and targeting the lower Co concentration as a threshold for enhanced Cu toxicity. The authors state that the cohorts were the same.

Comment 7. A true control (0 Cu, 0 Co) was not used in the Copper-Cobalt Interaction for the interaction tests. Survival in the controls from the LC50 studies was quite different, and would have led to a different interpretation of the data.

Response 7: There was 20% mortality in the Cu only controls, and 30% in the Co only controls by the end of the test due to starvation. This differs by 10%, which is slightly, but not "quite different". Average control mortality was subtracted from the exposure mortality before estimating LC50s. The interaction data were then interpreted by comparing the LC50 values, which are statistically robust.

Comment 8. None of the 6 studies used are adequate to establish a PRG from the existing data for invertebrates (i.e., salmonid food items). Daphnids are too sensitive. The BMSG provides examples to this effect for metals other than cobalt.

Response 8: EPA acknowledged this in the cobalt TRV position paper and has avoided basing the PRG on studies strictly based on *Daphnia sp.* The Trustees correctly point out that daphnids are not always the most sensitive aquatic species to metals. Daphnids are less sensitive to chronic effects of copper and cadmium based on data from the references cited by the BMSG. They note the daphnid value is 20, not 28, as stated by BMSG.

***Comments 9 and 10.** The Tier II value is "totally driven" by Daphnia data.*

Responses 9 and 10: The Tier II value is weighted by Daphnid data, but not totally driven because the Tier II approach is statistical. It is a function of the toxicity values and also the number of data requirements met. Removing the daphnid values does not change the resulting criterion for aquatic life (forage fish and invertebrates) by a factor of 4 as indicated by the BMSG. See the following table for a comparison of the ORNL Tier II value with and without the Daphnid data.

Parameter	Tier II (w/Daphnia)	Tier II (w/o Daphnia)
FAVF	4.0	12.9
SAV	1483	510
SACR	63.98	15.9
SCV	23	32

***Comment 11.** Sodergren cannot be used since potentially contaminated river water and failure to acclimate test organisms in the test water compromised the results.*

Response 11: This is an older study and some methodology used is not consistent with current standards (however, these same points can be made about the Warnick and Bell, 1969 study). The author stated that the pollution sources were absent for 2 months prior to the study; Co was analyzed and was found to be below detection. There is no reason to suspect bias due to organism treatment, although toxicity could be different (higher or lower). There were controls which did not exhibit unusual mortality/morbidity. A clear dose response curve was observed with increasing Co and toxic effects; and similar organisms occur onsite. This study was considered as an additional line of evidence.

***Comment 12.** Diamond (1992) cannot be used due to effects on control organisms. The lowest fathead minnow value is 1/10 the value generated by this study. Daphnia values drive the CCC.*

Response 12: Hardness did affect control daphnids. There were no such effects on control fathead minnows. The lowest acute value for fathead minnows (537 mg/L) is a 96-h LC50 from another source; it falls below the NOECs (1,232 mg/L) identified by Diamond by a factor of 2, not 10 as stated by the BMSG. The data are insufficient to determine why - strain sensitivity could play a role here as it did in the site-specific data. The difference argues for use of lower values as the PRG. Daphnia values are a major component of the Diamond value; for this reason this study was considered only as a line of evidence.

Conclusion

Conclusion Comment: *According to the BMSG, the PRG falls between 125 and 213 mg/L and a Tier II value without Daphnid data is 97 mg/L. Because Daphnia data are inappropriate, and all other studies flawed, EPA cannot establish values for invertebrates.*

Conclusion Response: A cobalt cleanup level protective of salmonids must fall below 125 mg/L because these data represent a short term NOEC and exposures to aquatic life in Panther Creek are chronic. The Tier II value recalculated according to the methodology in Suter and Tsao is 32 mg/L (or 62) , not 97 mg/L . A value can be established for invertebrates using the Tier II methodology developed by EPA and implemented by ORNL. It is designed to be used with limited data sets, and is overly protective in only 20% of the cases used.

The cobalt cleanup level should emphasize protection of salmonids. It should protect the food chain for salmonids so that adequate food supplies are present, but not necessarily be protective of community structure; thus the cleanup level can be higher than a Tier II value of 23 mg/L. The salmonid cleanup level of 38 mg/L is low enough to allow some protection of benthic invertebrates, as it is approximately the same value at which limited mayfly effects were seen. Therefore, the cobalt water quality cleanup level is sufficiently protective of salmonids and their food supply without being overly conservative.